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# PREFATORY NOTE.

When about to enter for the first time upon his duties as Professor of Clinical Medicine, and to deliver the summer course of Clinical Lectures for 1856, in the University of Edinburgh, the author looked about for some elementary work on the inductive philosophy which he could recommend to his class, for their instruction and guidance in clinical observation and research. He found several sufficiently able manuals of *physical diagnosis* adapted to students; and good elementary works on the uses of the microscope and on the *routine* of the clinical wards, with systematic instructions "how and what to observe." But he found none which instructs the medical student in a simple and

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# LECTURES

ON THE

# PRINCIPLES AND METHODS OF MEDICAL OBSERVATION AND RESEARCH

FOR THE USE OF ADVANCED STUDENTS
AND JUNIOR PRACTITIONERS.

BY

THOMAS LAYCOCK, M.D., F.R.S.E., F.R.C.P.

PROFESSOR OF THE PRACTICE OF MEDICINE, AND OF CLINICAL MEDICINE, IN THE
UNIVERSITY OF EDINBURGH, ETC. ETC.

> Homo, naturæ minister et interpres, tantum facit et intelligit quantum de naturæ ordine re vel mente observaverit;—nec amplius scit aut potest.
>
> BACON.

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TO THE STUDENTS

OF

THE EDINBURGH SCHOOL OF MEDICINE

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tiously applied by the youthful inquirer. Hence the numerous cautions as to these sources of error, whether in reasoning or in observation, which the writer has ventured to give.

In omitting all details as to the methods of using the instrumental aids to research (that is, the aids to the senses) which modern science has given to medicine, and which might have been introduced with perfect propriety, the writer by no means intends to disparage those aids; the omission is simply due to the circumstance, that they have already had a most fitting and ample exposition in various works, writ for the express purpose, and very generally in the hands of students. What he thought of more advantage was to point out the danger of too great a reliance upon those means of research, and of a too exclusive use of them. He also thought it a necessary thing to supplement and complete the manuals of physical diagnosis, by details as to *physiognomical* diagnosis. This singularly important department of practical medicine is as yet but rudimentary, and the author, therefore, has only ventured upon a mere outline. It is a department, however, which will amply repay culture. It will, in fact, when fully developed, add more to our available knowledge than physical diagnosis, in the same proportion as the reason penetrates more deeply than the senses into the nature of things.

It further seemed to the author of some importance that the student's attention should be directed especially to the natural history of disease, with a view to a more philosophical, more really practical, and more truly natural system of medicine than has hitherto been given to the world. Hence the introduction of a subject not often noticed, and when noticed, always imperfectly in systematic works—the order of succession of vital phenomena, and the other points discussed in the third lecture. This, however, is also but an outline of the subject.

In conclusion, the writer would remark, that he has adopted the present form, from a conviction, that the simple and familiar style of a lecture would be more attractive to the student than the rigid gravity of a set treatise. Of the lectures themselves it may be stated, that for want of time none of them was delivered *in extenso*, and some were not delivered at all.

RUTLAND STREET, EDINBURGH,
*September* 1856.

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# LECTURE I.

◆

## GENERAL PRINCIPLES OF OBSERVATION AND INQUIRY.

Introduction.—We are met to-day in order that for the next three months we may study and practise medicine together at the bedside of the sick. To us all these pursuits are of singular importance. To you, clinical study is the culmination of your academic career, and upon the habits you now form, and the doctrines you now imbibe, much of your success and happiness in the practice of your future profession will depend. To me, clinical teaching involves a grave responsibility; for to guide you rightly in your studies, as well by precept as by example, is to ensure, so far as I am concerned, that your career shall be successful and happy, and therewith human suffering largely alleviated, and the profession of medicine advanced.

And perhaps I may be permitted, once for all, to allude now to other circumstances which give me serious thought, yet of a more personal character. I am associated in this duty with gentlemen here present, who have already attained to a distinguished position as clinical teachers. As the successor of Dr. Alison, too, I follow one whom all men esteem and revere. The entire profession regret with you the loss of his valued instructions and his large experience. If, then, I doubt my ability to bend the bow of Ulysses, or fear to be put in comparison with those most able men to whom I have referred, I am sure the fear and the doubt may well be excused.

I need say hardly one word in commendation of clinical teaching. It is of singular advantage in every way. To the sick poor especially valuable, because it secures to them at small, if any, cost to their feelings, the most careful consideration of their case. To the public not less advantageous, because it is the best means of advancing medical art and of training students into good practitioners; to the student, it affords him an opportunity of meeting disease face to face, not easily met with elsewhere; and therefore of vital importance to you, since it enables you to secure the great object of all your studies. That object is the acquisition of those qualities which, included under the terms professional skill and tact, constitute the surest means of professional success. To aid you in attaining this great object will be equally my pleasure and my duty.

And first let me explain what I mean by professional skill and tact. Professional skill implies a knowledge of diseases, and of their most appropriate treatment. Professional tact, a quickness in applying that knowledge at the bed-side, and in directing and securing the most appropriate treatment. With a ready appreciation of the essential points in the case before you, there must be a decisive opinion of what is needed, and prompt action upon the opinion. In a few words, it may be said that the sagacious practitioner determines quickly and clearly what ought to be done, what can be done, and how what can be done may be accomplished. This is what constitutes professional skill and tact at the bed-side; and this you have to acquire.

But in your future career you will have to labour as members of the profession at large; that knowledge which you have received from past generations you must improve and increase. This is a duty not only to be done simply, but to be done with professional skill and tact—that is, to be done so that you will extend your own reputation, while you add to the domains of medical science and art. To this end your researches must be practical, while they are profound; philosophical in their method and aim, while they are laborious and minute. You must learn how to perform this duty.

Now, in the exercise of your profession with these objects, you are in hourly contact with your fellow-men, with no other power over them, under ordinary circumstances, than so much influence as their own desires or their personal esteem for you may supply. You have to collect evidence where no oath binds the speaker; to penetrate disguises; to sift conflicting statements; to reconcile improbabilities. Without the power to experimentalize—that is, to vary at will the circumstances, so as to disentangle the essential from the non-essential, or without even the power to cross-examine, you must come to a conclusion; often with but a moment for deliberation, you must act. And when you have determined what is to be done under the circumstances, still you will usually have no power to compel to the necessary course of conduct, except through those motives to action which are consonant with the hopes, the fears, the prejudices of your patient. To investigate a case rightly and to secure that the necessary measures be executed promptly and fully, you must be able to judge quickly as to these motives. This judgment can only be founded on a thorough knowledge of human nature, and this knowledge and the use of it, therefore, constitute important elements of professional skill and tact.

How, then, can I assist you in the acquisition of these qualities? By precept and by example only; yourselves must do the rest. I can explain to you what is the nature of the mental processes by which skill and tact are acquired. I can point out to you how to conduct those processes; what methods are to be followed in investigation; what errors to be avoided; what fallacies to be guarded against. I can, in short, give you a brief outline of a system of clinical research, and I can indicate to you in the clinical wards of the Infirmary how this system can be carried out. Here, then, I must deliver my precepts; there you must learn practically how simple and yet how difficult is the art and the study of medicine.

As to the plan I propose to adopt, it is this :—In the first place, and in the present lecture, I will lay before you my views as to the mental processes by which knowledge and tact are acquired. And, inasmuch as the tact to investigate and the tact to discover and treat disease are nearly identical in their nature, I shall consider the matter with reference to both these duties. While pointing out principles, I shall also point out fallacies and sources of error, adding practical illustrations. This will constitute an exposition of general *principles.*

In the next place, I will give an exposition of the *methods* to be followed, founded on the principles previously developed. I shall therefore point out the order and means of investigation; the leading phenomena to be investigated; and the rules for attaining satisfactory results—that is, all that it is possible, under the circumstances, to attain, whether in the investigation and treatment of disease, or the advancement of medical science and art.

In addition to skill in detecting, prescribing, and investigating, there is a tact required to secure the due execution of the measures determined upon, and the management of the patient to that end. This will also constitute a subject of inquiry.

## NATURE AND ACQUISITION OF EXPERIENCE IN MEDICINE.

EMPIRICAL DIAGNOSIS AND THERAPEUTICS.—What is requisite technically for a practitioner of medicine? He may be considered from two points of view. First, as the uninstructed man, guided by an unenlightened experience. Secondly, as the taught man, guided by enlightened experience. The one knows disease and its treatment solely from having often seen similar groups of morbid phenomena or *symptoms* made to disappear by the same agent. Each symptom, or group of symptoms, he designates as *a* disease, giving it a name, and the agent he terms *the* remedy for the disease. All he asks for is a cure for the disease—it may be a headache or a cough—without reference to the abnormal changes in structure and function upon which the abnormal phenomena depend. This is experience simply. From the earliest records of medical art to the present moment, we have abounding illustrations of this method of practice. Take as an example the Hippocratic treatment in a commencing case of Pleuro-pneumonia. "When pain seizes the side, either at the commencement or at a later stage, it will not be improper," it is recorded in the works of Hippocrates, "to try to dissolve the pain by hot applications. Of hot applications, the most powerful is hot water in a bottle, or bladder, or in a brazen vessel, or in an earthen one; but one must first apply something soft to the side to prevent pain. A soft large sponge squeezed out of hot water, and applied, forms a good application; but it should be covered over, for thus the heat will remain in the longer," etc. For the 2400 years which have elapsed since this was written no more simple, and at the same time equally effectual treatment of pleuritic pain has been discovered or practised, and it may be added, that to this day the *modus operandi* of the means has not been made out. Amongst the Hippocratic writings is the following as to the treatment of peri-pneumonic and pleuritic affections:—"If the fever is acute, if there is pain in one side of the chest, or in both, if the patient suffers during expiration, if he coughs, if the sputa are rusty, or livid, or thin, and frothy, or blood-red, or if they differ in any way from healthy sputa, it is necessary to act as follows:—The pain extending upwards towards the clavicle, or towards the nipple and the arm, the inner vein of the arm of the affected side should be opened. The quantity of blood drawn should be in proportion to the constitution of the body, the season, the age, and the colour;

and if the pain is acute, the bleeding should be pushed boldly to faintness,"—a plan of treatment not unlike the modern. These are illustrations of the simplest form of Empirical therapeutics, or therapeutics dependent upon the teachings of experience only.

EMPIRICAL PROGNOSIS.—Medical tact may be shewn in the perception of the cause or causes of a given morbid state, and of the results; in other words, of the antecedents and consequences. This knowledge was comprised by the ancients under the general term *prognosis;* by the moderns that term is limited to a perception of the event or consequences. As an illustration of empirical prognosis I give the following from the aphorisms of Hippocrates:—"In a fever not of the intermittent type, if a lip, an eyebrow, an eye, or the nose be distorted; or if there be loss of sight or of hearing, and the patient be in a weak state—whatever of these symptoms occur death is at hand." Here again is a simple enumeration of phenomena in a given order, without reference to the cause or seat of the disease. The term fever comprising all its past as well as present phenomena; the symptoms specially described are the prognostic phenomena, and death, the result, is predicted as necessarily following those symptoms. To the practitioner instructed in the physiology and pathology of the nervous system, such symptoms indicate a condition as well as a result, viz., a complication involving the base of the brain. Yet there is nothing to shew that the writer of that ancient record of medical experience had such knowledge. We are sure, nevertheless, that with practised perceptive powers he must have possessed a quick insight into the course of disease, although his prognosis be purely empirical.

EMPIRICAL ETIOLOGY. — Empirical etiology is on a similar footing. It is an instinctive pleasure of man's intellectual nature to look for and discover the causes of what happens to him—"*Felix qui potuit rerum cognoscere causas.*" Take an aphorism from Hippocrates, as to the influence of age in the development of phthisis: "Phthisis," he says, "most commonly occurs between the ages of eighteen and thirty-five years"—a general statement, which the application of the numerical method of investigation (one of the great intellectual means of discovery of modern times), made with the greatest care and on the largest scale, has only confirmed. The same remark applies to the influence of the seasons, as laid down by Hippocrates. The twenty-third aphorism informs us that the diseases of winter are, "pleurisy, pneumonia, coryza, hoarseness, cough, pains of the chest, pains of the ribs and loins, headache, vertigo, and apoplexy." The large numerical returns to the Registrar-General, with all the advantages of modern science, only demonstrate the truth of this aphorism; yet it is purely empirical.

COMPARATIVE MERITS OF EXPERIENCE.—These statements sufficiently prove the uses and even value of unenlightened simple experience in medical art; but do they prove its excellence? No. Such experience is the most common thing in the world. Every man with opportunities for observing, and a mind for estimating, the relations of the phenomena that come under his daily cognisance, acquires each, in his profession or business, the same kind of tact. The Indian warrior on the trail of his enemy has not more acute tact in observing and concluding, than the detective police officer in quest of his object of pursuit—the forger or murderer. The common seaman or unlettered shepherd will anticipate far more readily than the experienced statesman the coming changes in the weather; but the statesman has equal tact in his vocation.

After a long life spent in the public service, at an age

> When old experience doth attain
> To something like prophetic strain—

he can anticipate the course of events, and foresee the political storm; and, if vigour of mind be left to him, can guide warily and well the helm of government. Such a statesman was the late Sir Robert Peel—the physician of the sick commonwealth.

Now, experience has its principles as well as philosophy; for experience *is* philosophy—the philosophy of common sense; and it is well that you should know that these principles are nothing more than the aphorisms, proverbs, maxims, and wise sayings, current in the world. These are the pith and essence of multitudinous experience, professional, moral, domestic, or national, as well as physiological and pathological. In a word, they constitute empirical knowledge. The proverb, to mention a solitary instance, of "Conceit (or the fancy, imagination) will kill, and conceit will cure," is an embodiment of the philosophy of globulistic and mesmeric therapeutics. The acquisition of a certain amount of medical knowledge, by uninstructed daily experience, is equally illustrated by the proverbial saying, "A man is either a fool or a physician at forty."

What, then, is the requisite conduct for the attainment of the wise experience of which I speak? Simply this; long-continued, sedulous, accurate observation of manifest external phenomena—observation independently of aids, and therefore prompt, because practicable under all circumstances, in which the eyes, the ears, and the senses generally can co-operate with the instinctive exercise of the judgment, or common sense, as it is termed. There must be the practised eye and ear, trained by long use; the practised judgment, trained by careful exercise. All men have not the natural qualities; many want the industry; but to those who have both, experience will afford a power of intuition such as is sometimes really marvellous in its results.

FALLACIES AS TO THE USES AND VALUE OF MERE OBSERVATION AND EXPERIENCE—But, after all, unlearned experience is not the best guide, nor empirical knowledge real science; and this is a fallacy against which I must warn you; for it is a very common one. Medical practitioners in all ages, noting the great value of simple experience, and seeing how far away from truth and common sense men have been led by theories and hypotheses, have put simple experience forward as something better or more instructive than the combination of observation with theory—esteeming them as only mischievous elements, and to be avoided at all cost. Now, this notion is, in fact, a theoretical notion; for experience itself teaches us two great principles or maxims as to what is termed theory or hypothesis—namely, first, that theory *cannot* be dispensed with in observation; and secondly, that theory, rightly used, is a necessary element not only in the advancement, but in the practical application of all human knowledge. Let me illustrate these propositions by facts drawn from experience, and by arguments upon those facts.

Sydenham has had conferred upon him the title of the English Hippocrates. Undoubtedly, he stands out as one of the greatest men of the modern era of medicine. Now he, of all men of his era, has most strongly inculcated the empirical method of observation and inquiry, to the exclusion of theory or hypothesis. To shew this, I will quote him. "In writing the history of a disease," he says, "every philosophical hypothesis whatsoever that has previously occupied the mind of the author should lie in abeyance. This being done, the clear and natural phenomena of the disease should be noted—these, and these only. They should be noted accurately, and in all their minuteness, in imitation of the exquisite industry of those painters who represent in their portraits the smallest moles and the faintest spots." In these directions Sydenham is influenced by two hypotheses—first, that just as there are species of plants, there are also *species* of diseases, which have their clear and natural phenomena; and secondly, that nature, in the production of disease, is "uniform and consistent." He therefore roundly asserts, what is in fact contrary to the experience of us all, "that for the same disease in different persons the symptoms are for the most part the same, and the selfsame phenomena that you would observe in the sickness of a Socrates you would observe in the sickness of a simpleton." Now, diseases are really series of events, and not well-defined objects, as plants or animals, and these events vary as infinitely in combination as the natures of the individuals to whom they happen; so that it is a medical proverb or maxim, that in practice "No two cases are alike." Sydenham was hypothetical, then, even in laying down his method; was he less so in carrying it out? Let us look at one of his "Histories," and take up that of vernal intermittents. Strange to say, he adopts a series of hypotheses to explain hypotheses! "Now, during the cold of winter," he says, "the animal spirits become strong and concentrated, from their recess.

In the meanwhile, viscid humours (less viscid, however, than those that the heat of the previous autumn had wrought up even to seething and boiling) have been accumulated by nature during the whole winter in the volume of the blood."

"Against these the animal spirits struggle—they try to fly off; but they get entangled, and netted in, and held back."

"This it is that excites the vernal ebullitions."

"Exactly in this manner do full beer barrels that have lain long in cool cellars, or in sand, begin to work as soon as they are set near a fire, when their liquor becomes ready to fly."

"The blood does the same."

"Similarly affected it tries to clear itself; and it does its work quickly when the volatile spirits second it," etc.

We need not be surprised, after this, that Sydenham had a hypothesis also as to diseases, namely, that they arise "partly from the particles of the atmosphere, partly from the different fermentations of the humours." Nor is it at all remarkable that he was equally hypothetical in his practice, which in fact he was. It is not necessary to multiply illustrations of this kind. No man was ever great in medicine on the principles laid down by Sydenham, for no man ever could be; all, therefore, of the greatest thinkers will be found to be theoretical or hypothetical. What is common to them all and really distinguished them all, as it distinguished Sydenham, is this—the combination of accurate, sedulous, minute observation with theories and hypotheses.

## THE COMBINATION OF THEORY WITH EXPERIENCE AND OBSERVATION.

NATURE AND USES OF THEORIES AND HYPOTHESES.—What, then, you will ask, is the nature of hypothesis or theory in medicine, and what the use? I will endeavour to explain to you. Experience shews that in medicine, as in every other branch of human knowledge, thought itself is impossible without hypothesis or theory. We instinctively desire to understand all that we observe to occur. No man can be content with mere perceptions, for these are only the *stimuli* to thought. After observation comes comparison with what we already know, and conclusion or inference from the comparison. This conclusion is a theory, which would be perfectly true if the data were complete and correct; but they are not. Our observations are imperfect, our knowledge is imperfect—our conclusion, therefore, reflects the imperfection of our observations and of our previous knowledge, and is never true, but always hypothetical or theoretical; varying from the truth, just in proportion as we are ignorant or imperfect observers. Having drawn our conclusion—that is, formed our theory, we may or may not rest satisfied with it. If we wisely doubt, then we desire to verify it by observation or experiment; or if the conclusion be as to something attainable, we endeavour to attain. And this is only another way of testing the theory by experience. To theory, then, in this sense, that is, tested by observation or experiment, or experience, we owe all true progress in knowledge, for empirical knowledge is stationary. If Columbus had not had a geographical theory of dimly-conceived western lands, and the great kingdom of Cathay, he would never have set forth on his voyage of discovery. Without theory, Harvey would not have unfolded the circulation of the blood. Without a theory, the grand laws of the universe would not have been revealed to Newton, and this Newton knew well.

Sir David Brewster, in his Life of Newton (vol. i. chap. 3), gives a history of Newton's discovery of the composition of white light. The student will find in that history an interesting illustration of the uses of theories and hypotheses in research. Newton propounded successive hypotheses or "suspicions," and experimentally investigated the phenomena of the prism in reference to each, until he arrived at a satisfactory explanation. Every hypothesis, therefore, except the last was necessarily erroneous; but the investigation of each added to his knowledge, and brought him nearer to the truth.

THEORY NECESSARY TO INVESTIGATION.—You must, therefore, by the very constitution of your mental nature theorise as well as observe. You cannot avoid it, try you ever so; to attempt it, is to attempt an impossibility. In every case that you investigate, in every remedy you prescribe, you form one theory at least, if not many; nor can you make any advance in science or art without it. What, then, concerns you, is to know how you may theorise to the best advantage, and what errors you must avoid in the process; to learn, too, how to estimate the theories of others; for since theory is absolutely necessary to thought, all expressions of thought, whether they be evinced in *collective* words, as "irritation," "inflammation," "fever," "tonics," and the like, or in collective theories termed *systems*, are more or less hypothetical, and are therefore more or less fallacious.

Let us look at this matter as it concerns your own minds in your vocation. When you begin the investigation of a case, that is to say, of the condition of a person in a state of disease, what are the steps that you instinctively take? These. You note some of the phenomena, and associate them in your mind by the process termed association of ideas, with other phenomena, or conclusions as to other phenomena, which you have either yourselves witnessed already, and thought of, or have heard or read of as witnessed by others. You notice a similarity, perhaps, and you come to the conclusion, probably erroneous, certainly theoretical, that the two are identical. This conclusion, if drawn from your individual experience, will lead to another conclusion, founded also upon your individual experience, as to what will be beneficial or injurious to the sufferer—or, in other words, the *treatment* of the patient. If, as will be the case, the conclusion be drawn from a more complex source, viz., the recorded theories and experience of others, then a knowledge of medical science enters into your conclusions.

NO TRUE THEORY POSSIBLE WITHOUT SCIENCE. —Now, disease may be simply defined to be a deviation from the normal state, either of structure, or function, or both. To know this deviation in its full extent, that is to say, its origin or causes, its nature, its course, and its remedy, implies at least a knowledge of healthy function and structure, or the science of physiology; of the agents which cause deviation from the normal state, or etiology; and of the mode in which those agents act, or pathology. All recorded theories and general terms, and all your conclusions, will therefore be applicable and complete only in proportion as they are founded upon this knowledge. Hence, your estimate of theories, as well as your power to comprehend and control disease, will depend upon the amount of your physiological, pathological, and etiological knowledge. In proportion as this is extensive and accurate, will you be successful as practitioners and investigators. Here, knowledge is synonymous with power; and in this respect a junior medical student of the present day is far superior to a Hippocrates or a Sydenham.

THE FALLACIES OF THEORY DETECTED BY EXPERIENCE.—But however great the amount of knowledge of this kind you possess, it will not preserve you from fallacies; on the contrary, you may be the more seduced into them. Knowledge puffeth up; and theories, which are perhaps hardly a shade better than those that have been justly rejected, either take the place of facts in your conclusions, or are retained as being true, or at least sufficient explanations. Physiology and pathology are full of these false facts; in therapeutics they crowd upon us on every hand. Now, there is a very simple method of trying the value of a theory, and that is to put it to the test of experience. This is the Ithuriel's spear for all those hypothetical conclusions or theoretical views you may be tempted to adopt. It is the great secret of success in all researches; nor is it difficult, for it is what you will have to do every day in the actual treatment of disease. Your diagnosis is confessedly but a probability; your treatment will test its worth.

## ILLUSTRATIONS OF THE FALLACIOUS USE OF THEORIES.

FALLACY OF SUBSTITUTING A THEORETICAL WORD FOR A FACT.—I will now point out to you, by way of example, some of the principal errors you will have to avoid in your observations and inquiries. The first and greatest of these is the substitution of a theory for a fact—a probability for an actuality. This is so common an error, that you can hardly open any medical essay without meeting with it, and it is a very insidious error. There are two or three principal modes in which it occurs. One is the use of collective words or general terms, as facts, which are essentially theoretical, as "tonic," "diaphoretic," "fever," "inflammation," and the like. In the search after accuracy, a definition is given, and then it is thought that the word has a definite meaning. This is not so, however. Naturalists have not even defined what a species is, although they have only objective phenomena to deal with, and can place the objects before them. In defining processes and states of living bodies, we must remember that we do not know the entirety of any one process, for we have never observed it—sometimes, indeed, only a small portion of a process; as to the remainder, we draw conclusions only, that is, establish theories or probabilities. Nothing is so difficult to handle in this way as the phenomena of life, because all vital phenomena are continuous, or run into each other. It is this continuity that renders it all but impossible to define a species with absolute strictness, or even what is animal and what vegetable. All words and terms in medicine, then, are sources of fallacy; and this being so, it is not difficult to comprehend how all systems, as they are called in medicine—that is to say, methods of cure dependent upon one or two falsely called principles *must* be erroneous. How absurd the therapeutical dogma of *similia similibus curantur* appears from this point of view. No diseased individual is exactly like another individual; nor, in the same, is the condition of one day like the condition of another. It is a mere assumption that they are.

An illustration of this kind of error may be drawn from the theoretical use of terms in pathological anatomy, or the anatomy of disease. No method seems so sure as that of dissection for determining the nature of a disease, and pathological anatomy has therefore always attracted earnest and enthusiastic minds to its culture. The phenomena are often visible and tangible, or, if not, then there is the microscope and chemical analysis; and the inference naturally follows, that the method is sufficient for the determination of the nature of disease. Brought to the test of experience, that crucible of all theories, we find that the hoped-for certainty is wanting. Nothing, for example, seemed so settled by histologists as the characteristic forms of cancer-cells; recent discussions and experiments have shewn, however, that there is not that settled agreement on this point amongs microscopic observers, as was alleged, and for this reason, that the nature and forms of the cells arise out of a general *theory* of the cellular structure of cancer-growths. Theories, dietetic or therapeutical, founded upon the varying chemical composition of the urine, appear in succession; each is received for a time as a satisfactory theory, and is then proved by experience and observation to be erroneous. So, also, with theories of inflammation, and its sequelæ; these would appear surely within the domain of histology and chemistry; but all such attempts to demonstrate the nature of inflammation fail, for a satisfactory definition of what inflammation is, has never yet been advanced. Nor is it probable that attempts of this kind will ever succeed, seeing that the entirety of the group of processes known under that name have never been observed, any more than the entire processes of the living organism. We have, in fact, observed and investigated only a portion, and that a very small portion, of the inflammatory process.

FALLACIES OF GENERAL PRINCIPLES AND OF SYSTEMS FOUNDED THEREON.—All kinds of false systems of medicine manifest therapeutical theories and fallacies. Homœopathy, hydropathy, and mesmerism are the three principal of modern times. Homœopathy has for its basis two dogmas: the one to which it owes its name of *similia similibus curantur* I have already noticed; the other is, that infinitesimally small doses of drugs powerfully influence the vital functions. Let us touch this dogma with our Ithuriel's spear of experience, and ascertain, in the first instance, whether the infinitesimal dose be administered. The process by which the dose is obtained is theoretically one of minute division and subdivision; but is it really such? What is the proof that the theoretical subdivision into infinitesimally minute fragments or portions takes place? There is no proof; it is simply an assumption founded on another assumption, that the particles so treated are capable of infinitesimal subdivision. But does this assumption correspond with the fact? Various plausible arguments only are brought forward in support of it, chiefly from analogy; but these are of so vague and erroneous a character, that they need hardly be mentioned; as for example, it is alleged, that odorous bodies *must* give off infinitesimally small particles, inasmuch as they manifest no appreciable diminution of weight after many years. But is it not a more reasonable inference, that in the particular instances mentioned, the odour is not at all dependent upon particles given off from the odorous body? Were it otherwise, they would at last shew a sensible, although a very small, diminution in weight. And even if the argument be allowed as to odorous bodies, how can it apply to the inodorous, as chalk, charcoal, bichloride of mercury? When, in addition to the teachings of experience, we have facts as to the atomic constitution of bodies, which imply limits to the divisibility of matter, we may well feel justified in rejecting the whole system of medicinal therapeutics founded upon the infinitesimal hypothesis, because wanting in the primary fact that an infinitesimal dose is administered.

FALLACIES OF THERAPEUTICAL THEORIES.—But there are amongst the class of unsectarian practitioners, men who, misled by fallacious terms, treat symptoms like the homœopathic sectarian; they err in the same way, but in the other extreme. These assume to be exemplifications of the "practical man." They are unhesitating believers in phrases, in the names of symptoms, and in classes of drugs. For each symptom they have a remedy, and talk of tonics, alteratives, astringents, febrifuges, not being in the least aware, apparently, that every word they use involves a complex and very doubtful theory. They are necessarily theorists in practice of the worst kind, because they do not even suspect that they are theoretical. So far from being practical in their methods of treatment—that is to say, adapting it to the morbid conditions in which the individual is involved as a unity—they only look at special or isolated morbid states. The result is, the administration for the cure of disease of a frightful farrago of drugs, more dangerous even than the nullities of homœopathy. This error has had a very seriously injurious influence on the profession as a whole, as well as upon medical art.

As an illustration of this error, I will read to you a prescription composed by a graduate of a distinguished English university—one of that class of self-styled practical men who habitually seek to exalt themselves above what they term the theoretical practitioner. "Take of nitric acid, of hydrochloric acid, of medicinal hydrocyanic acid, each half a dram, fluid extract of sarza two ounces and a-half, tincture of hop six drachms, syrup of orange peel four drachms, compound infusion of gentian six ounces, acacia gum mixture one ounce and a-half, camphor mixture four ounces and a-half. One ounce to be taken three times a day." This was prescribed for a man aged forty-five ; and we may theorise on his case thus:—He had probably the syphilitic cachexia, for which the sarza and nitric and hydrochloric acids were prescribed; the hop perhaps aimed at nocturnal pains; the hydrocyanic acid and acacia gum at an irritable stomach; the orange peel syrup, camphor, and compound infusion of gentian, at a want of appetite. The object of another farrago I will read is not so clear. "Take of powdered cinchona ʒij, powdered rhubarb gr. x, compound cinnamon powder ℈i, aromatic spirits of ammonia ʒij, spirit of cinnamon ʒij, white sugar ʒij, spring water to make a ℥xij mixture. Let him take ℥j three times a day, and twelve drops of the syrup of the iodide of iron with each dose." This dose contains fourteen ingredients, one of them, cinnamon, in three different forms. Such are the results of unchecked therapeutical theories.

Fallacies in the Indefinite Use of Theoretical Terms.—But the fallacies that lie hid in terms have another bearing upon practice of some importance. They are not theoretical alone, for they are indefinite also, and are used therefore in several meanings. Take as an example the word dyspepsia. It means painful digestion, or indigestion—a change of function only, but a function which is itself of an obscure character, and carried on by an organ with numerous imperfectly understood pathological relations to other organs of great importance, as the cerebrum, heart, liver, kidneys, uterus. So that this word dyspepsia, intended to imply a special derangement of function, really includes a multitude of diseases of the most opposite character, so that, to be at all explicit, there ought to be a nosology of dyspepsia. How impracticable, then, is it to discuss the treatment of dyspepsia in its usual vague sense. The term pneumonia is another of those indefinitely comprehensive words which the progress of nosology and pathology has rendered still more comprehensive and indefinite. Cullen used it to indicate all acute inflammations within the thorax, of which he had two classes—pleurisy and peripneumonia. These terms for the 2400 years antecedent to the time of Cullen had been used in the same sense, and it is evident applied equally to bronchial as to parenchymatous inflammation of the lung. But in the present day, bronchitis (a term unknown to, or before Cullen), is a distinct species, and the term pneumonia expresses essentially inflammation of the air-cells or aërating tissue. Were it limited even to this anatomical definition, there would be confusion enough, but we find that, like the term dyspepsia, it has been used to indicate a *group* of lung-diseases, of which several differ widely as to their etiology, nature, and termination, demand the most opposite modes of treatment, or require no treatment at all. It is a group which, when reduced to a common expression, may be described as presenting interruption of the respiratory function, with certain auditory phenomena termed physical signs. In one form the rational symptoms, in another the physical signs, in another the pathologial changes in structure, in another a blood-affection, are, in fact, the characteristics of the pneumonia. I know nothing more puzzling to the student, however necessary to the progress of science they may be, than these shifting and varied, as well as vague uses of collective words.

FALLACIOUS USE OF THEORIES AS TRUTHS IN INVESTIGATION.—But there is another important source of error of a somewhat antagonistic character to the last mentioned, which you should also guard against, and that is, that bias of the judgment which leads to the retention of theories and hypotheses as if they were truths. You will already have fully comprehended that a theory is a means to an end only, namely, the progressive discovery of the order of events. It has been likened to the scaffolding of a building which is in progress, and which is pulled down so soon as the work is completed. Or truth may be compared with a besieged fortress, and theories considered as the trenches opened against it—each parallel being deserted so soon as it has served its purpose—that of enabling the besiegers to open the next. It is just as fundamental an error in science to retain those theories as if they were truths, as it would be in war to retain trenches, as if they were the captured fortress.

Theories thus used are injurious in two ways—to the successful treatment of disease as well as to the successful cultivation of the art. In fact, all observation, and thought, and action are bent to the favourite theory. It is in this way a practitioner, if he have a favourite pathological theory, finds almost every case to be nervous, or hepatic, or spinal, or renal, or uterine, or else every disease is treated by fixed routine, according to a favourite therapeutical theory; it matters little whether the staple be mercury or mesmerism; bleeding or the water-cure; kinesipathy or purgation by Morrison's pills.

Perhaps no mistake has been more obstructive to scientific discovery than this; that of the circulation of the blood may be mentioned as an example. Aristotle had a theory of flux and reflux of the blood during waking and sleep, which he compared to the flux of the Euripus, and for 2000 years men's minds bent unquestionably to the theory. In 1569 Andrew Cæsalpine, a distinguished anatomist, stated concisely all the anatomical and physiological facts necessary to a knowledge of the circulation. He pointed out the function of the semilunar valves; he shewed that the blood could only enter through the vena cava at the right ventricle, and pass thence to the lung, whence it came to the left ventricle, and out of which it flowed through the aorta. He had only in fact to seize the idea that the blood *circulated* through the body, and not *oscillated*, and the discovery was made. Unfortunately he had a preconceived theory, that of Aristotle; and he used his facts to explain *it;* and thus he theorisingly passes by the great truth.—"Now," he says, "while awake, the movement of the innate heat is from within outward, and during sleep it is the reverse; hence it follows, that while awake a great quantity of the vital spirit and blood are carried to the arteries, which transmit them to the nerves; and during sleep the same heat returns to the heart, not by the arteries but by the vena cava, which alone communicates with this organ. In this manner the flux and reflux of the blood toward the superior and inferior parts, like the waves of Euripus, manifest themselves during sleep, and when we are awake also. The same species of movement is manifested either by applying a ligature around some part of the body, or by pressure on the veins in any other way." This was written in 1569. It remained for Harvey, nearly half a century later, to demonstrate the true theory of the motion of the blood in 1616, and publish it in 1628. This same tidal theory, which delayed the discovery of the circulation, also prevented its reception by all those of the older anatomists who implicitly believed in Aristotle. Apart from these, Harvey's discovery experienced a ready and even cordial reception.

Practical medicine presents many similar examples of this fallacy. Thus, at one time it was accepted as a settled truth, that the buffy coat on blood drawn from the arm was not only a proof of inflammation, but of the necessity of drawing blood for the cure of it. Routine practitioners consequently abstracted blood from the body in quantities that seem almost incredible, *e.g.*, one and a half gallons in five days. Again, a discussion has been constantly raised whether tubercular deposit be "inflammatory" or not in its nature—a question asked, on the assumption that the current doctrines of inflammation are settled truths, which they are not. The remedy for this class of fallacies is to disintegrate the general facts expressed by or under the theory; as, for example, in the instance of inflammation, in which, in some cases at least, the process is one of morbid nutrition, as well as of morbid vascular action.

COMPOUND FALLACIES FROM THE WRONG USE OF THEORY IN CAUSATION.—You must not gather from these special illustrations that these are all the fallacies to which you are exposed in executing the necessary process of theorising; they are only a few. Specially to be guarded against, are what may be termed compound fallacies, that is, mistakes in both observation and theory. I will shortly point out one or two instances of this kind of error.

In *observation* there is a twofold mental process going on; we have, however, only considered one, namely, that which is directed to ascertain the *nature* of the thing observed; but we also seek to know the *cause.* Now, etiology, or the doctrine of causation in disease, is a large and most important department of medical science; and the student should know well what is meant by cause, and how it is discovered. Cause is a term signifying the necessary and constant antecedent to an event. To discover causes is nothing else, therefore, than to find out what is the constant and necessary order of any series of phenomena. Thus, when croton-oil is administered, and excessive purgation succeeds to the administration of the drug, we say that the oil is the cause of the purgation. This conclusion is reached by no other logical process than this, that when the intestinal tube is duly continuous, and the intestinal mucous membrane in its normal state, the administration of croton oil always is followed by purgation—that is to say, by increased peristaltic action of the tube, and augmented effusion from the mucous membrane. In this example, we have an illustration of empirical observation. But we also theorise as to the mode of action of the drug. We note that croton-oil acts on or "irritates" the skin in a certain way, whenever it is applied to it; we compare the two groups of phenomena, and we infer that the oil acts on the intestinal surface, when applied to it, in the same way as it acts on the skin. This action we also say is the cause of the purgation; but it is, again, the order of the phenomena which determines the inference as to the cause. The process differs from that just described mainly in this, that our knowledge of the relation of croton-oil to the surface of the body is made a constituent element, and we theorise as to the order of phenomena.

FUNDAMENTAL FALLACY IN THE INVESTIGATION OF CAUSE.—Well, then, what are the fallacies to be guarded against in this process of causality? Fundamentally this—Experience shews us that we do not and cannot perceive the complete order of any series of vital phenomena, not even in apparently the simplest. In the illustration just given of the action of croton-oil we are yet much in the dark as to the next group of causal phenomena antecedent to the increased peristaltic action and effusion. We have theories as to the innervation of the muscular tube from the sympathetic ganglia and spinal cord, and as to the function of the capillaries, the epithelial cells, and the mucous crypts; but the theories are manifestly incomplete, and therefore our knowledge of the entire circle of phenomena is necessarily imperfect. Yet, however imperfect our knowledge may be, we inevitably come to a conclusion as to the order of causation; and the relations that are most on the surface, or nearest to our apprehension, are those which we adopt. This is the source of the "*post hoc-ergo propter-hoc*" logic of common life, and of all the pursuits of mankind, as well as of those purely medical. One or two simple illustrations will suffice to shew this fallacy and its remedy. Until within the last twenty years, it was an uncontroverted doctrine in England that ripe fruit, and especially the plum, was the "cause" of the diarrhœa and cholera prevalent in the towns and villages during the hot months of summer. Even so lately as October 1848, the English General Board of Health set forth this theory in their official notification to the boards of guardians as to the means to be adopted for the prevention of cholera—in which we have this paragraph. "It will be important also to abstain from fruit of all kinds, though ripe and even cooked, and whether dried or preserved." By way of proof, certain facts are subjoined, as thus—"The three fatal cases [of cholera] that have just occurred to sailors who had been at Hamburgh, and who were brought sick to Hull, turned out, on inquiry, to have followed very shortly after the men had eaten a large quantity of plums, and had drunk freely of sour beer." Note the wording—"Very shortly after"—as illustrative of the mode in which this fallacy arises. The nearest phenomena to the event to be explained are seized upon as "the cause." The becoming sick at Hamburgh, where cholera was raging, is not noticed; this important fact, indeed, is omitted from the statement; nor is there a word as to the medicinal treatment, or as to other articles of diet. Doubtless, in this particular instance the illustration was given to clench the caution against ripe fruit (the sour beer not entering into the theory), but which caution is itself founded on fallacious observation. This is so generally understood now, that I need hardly to tell you, that ripe fruit, moderately taken, is one of the best prophylactics against the summer cholera, diarrhœa, and dysentery. Nor need I add, that of the large number of the poor attacked, amongst whom diarrhœa is proportionately much more prevalent than among the rich, it is only a very small minority that have the means to purchase ripe fruit in sufficient quantities for daily consumption, or even to purchase it at all. This long prevalent dogma, then, as to the bad effects of ripe fruit on the alimentary or intestinal canal, when tested by experience, is found to be nothing more than a very fallacious inference from a wholly erroneous observation.

FALLACIES OF ANATOMICAL ETIOLOGY.—A fallacy in the determination of causation is very common in researches into the anatomy of disease. Certain abnormal conditions of structure are discovered after death, and it is at once inferred that these are the causes of the symptoms observed during life, or, in other words, constitute the disease. In this way the terms phthisis and consumption, originally used to express a wasting or diminution in bulk of the living tissues, have come to signify a certain kind of abnormal structural change, namely a so-called characteristic *deposit* in living tissues, or tubercle. And inasmuch as it is usually found that the lungs are the seat of this deposit, *pulmonary* phthisis and *tuber-*

*cular* phthisis have become convertible terms. But, in truth, the disease, etiologically, is that on which both the wasting and the deposit depend—that is to say, a morbid condition existing antecedently to any perceptible structural change, and without which neither the true phthisical tabes nor the true tubercular deposit will occur. This fallacy is of constant occurrence in anatomical researches into disease, and by insensibly leading the minds of practitioners rather to the results than the processes of morbid action, has seriously checked the progress of practical medicine.

USE OF FALLACIOUS TERMS IN EPIDEMIOLOGY.—The class of complex fallacies is again admirably illustrated by the current etiology of epidemics. In the usual investigations of this class of causes, we note every one of the errors I have laid before you. It is asked, for example, is cholera an infectious disease? Can cholera be communicated?—in the most perfect good faith, and without the slightest suspicion, that in the use of the collective term itself, there is a fundamental fallacy. Cholera is but a word by which a group of symptoms is indicated; it is not a thing. The questioner meant, therefore, to ask this question—can the *materies morbi*, the cause of the symptoms, be generated in the bodies of the sick, and communicated to the bodies of the healthy, so that in them a similar disease, or group of symptoms will result? Now it has in fact been assumed, without due inquiry, that the group of symptoms designated by cholera are the only phenomena which resulted from the *materies morbi*; so that during the whole of the first epidemic at least, it was hardly guessed that, etiologically, the immensely greater number of cases of diarrhœa were instances of slight cholera, that is, due to the same cause. I need only add, there was still less suspicion, that in such slight cases the *materies morbi* might be generated and given off equally as in the more intense forms.

This fallacious use of a collective term interferes with the advance of our knowledge in all the more important epidemics, as plague, yellow fever, influenza; the materies morbi of each of which, as experience will show, excites widely different symptoms.

Another illustration of the fallacious substitution of a theory for a fact in causation is afforded in the current theory of the rapid spread of the epidemic poison which excites the group of phenomena termed influenza. It is highly characteristic of a strictly infectious agent, and but for the circumstances that an insidious unperceived theory takes the place of fact in the consideration of the question, would suffice to establish its infectious character. So soon as the mind addresses itself to the question of causation, it instinctively compares the mode of the spread of influenza with its knowledge of the mode of the spread of other epidemical diseases that are known to be infectious, as the exanthemata. But it finds that the identical characteristic of influenza which, to an unbiassed judgment, would most strikingly indicate its infectious character, namely, its rapidity of spread, is wholly different from these. They require many months to infect an entire population; influenza never requires as many weeks. This dissimilarity being noted, and no other facts as to influenza being brought into comparison, the inference is drawn, that the diseases are really dissimilar as to the contagious element, and that the influenza spreads too rapidly to be caused, like them, by an infectious agent. Then, as the mind cannot rest satisfied without a cause being assigned for the rapid spread, the agent nearest the apprehension—namely, the atmosphere—is selected, and so it is concluded that influenza spreads in consequence of some change in or unusual "influence" of the atmosphere. This false theory of epidemic causation is not peculiar to influenza; it is the most common, as well as the most mischievous of the epidemiological fallacies. Since the days of Sydenham, who in modern times gave it extended currency under the term "*epidemic constitution*," it has obstructed our progress in ascertaining the true nature of epidemic diseases, and has been erroneously applied equally to cholera, plague, yellow-fever, as to influenza.

EXPERIENCE THE TEST OF COMPLEX FALLACIES. Experience is the test of these complex fallacies, as well as of the more simple. The theory of epidemical constitution has been tested by it, and, with the aid of an improved and extended system of meteorological observation, it has *not* been shown that any single or specific change in the atmosphere is constantly antecedent to the influenza or the other epidemics. Or we may test it in another way—namely, by inquiring what are the conditions under which the exanthemata actually spread, as epidemics. Firstly, it is necessary to this, that the bodies of the sick, or their clothing, be brought into proximity with the bodies of the healthy, or their clothing, so that the necessary communication may take place. This being granted, how does the communication take place as to the exanthemata, and as to influenza respectively? Thus. As to the former, the individuals affected are secluded at home; persons susceptible of the action of the *materies morbi* avoid them; and so comparatively few persons in a given time are placed under the condition necessary to infection. As to the influenza, it is not believed to be a contagious disease; the individuals attacked are not secluded for the most part at home, but go about everywhere, and *many* persons are thus *quickly* brought into the condition necessary for infection. Another element, is the time required for the generation or multiplication of the poison in the sick individual; for in proportion as this is short will the epidemical diffusion be more rapid. Another is the number of persons who are not liable to be affected by the poison. Others might be mentioned, as the surface of the body, from which the materies morbi is given off; as to whether it is gaseous, or held in solution in watery vapour, in the fluids of the body, etc. These, however, are not necessary to establish the illustration.

RECAPITULATION. — This must conclude what I have to say as to the principles of observation, and as to the sources of error. Let me shortly recapitulate. I have shewn, 1. That medicine is necessarily a conjectural art—necessarily, because in the present state of physiology, pathology, and therapeutics, a positive science, which can alone give rise to positive art, is not attainable. 2. That experience, derived from careful, sedulous, and accurate observation and experiment, is the safest source of practical knowledge, and the best test of all theories. 3. That for the advancement of all knowledge, and its application to practical uses, theories and hypotheses cannot be dispensed with; but that, on the contrary, they are essential even to observation, and to the best use of a matured experience. 4. Consequently, that both theory and observation are necessary to the practitioner—theory, by pointing out what needs to be observed; observation, by correcting and enlarging theory. Thus, in the world of mind as in the world of matter, movement depends upon two antagonistic but mutually adapted powers. These constitute its great sources of motion; it is by these and these only, that the human intellect can advance along an ever-widening circle of light and knowledge. In subsequent lectures, I shall shew how these principles are the essential elements of all methods of observation and research, whether it be desired to observe a particular case, and determine its nature and treatment, or whether to investigate groups of phenomena by the numerical and inductive methods. Finally, let me say that these doctrines are not new; they have the stamp of twenty-five centuries upon them. All the world knows the aphorism which opens the curative maxims of Hippocrates—an aphorism that concentrates within it the results of a wise experience in clinical medicine—Life, says the father of medicine, is short; art is long; opportunity is fugitive; experience is deceptive; judgment is difficult. Or, as paraphrased by a sweet transatlantic, but English poet, with a medical turn of thought—

> "Art is long, and time is fleeting,
> And our hearts, though stout and brave,
> Still, like muffled drums, are beating
> Funeral marches to the grave."

And therewith there is a moral, not to be forgotten by us who can do nothing except by patient labour.

> "Let us, then, be up and doing,
> With a heart for every fate;
> Still achieving, still pursuing,
> Learn to labour, learn to wait."

In subsequent lectures, I will endeavour to indicate and describe the methods best adapted to "achieving and pursuing" in medicine.

# LECTURE II.

## GENERAL METHOD AND OBJECTS OF CLINICAL STUDY.

INTRODUCTION.—I have already stated that the basis of all medical science and of practical tact is experience. Now experience in any art is not otherwise attainable than by the practice of the art. The foundation of medical experience is observation of disease, and the requisites to successful observation are minuteness and accuracy. The clinical student must therefore make up his mind to be sedulously minute and carefully accurate in investigating the cases under his notice. These two qualities are so important, so absolutely essential to success, that he cannot be too assiduous in the cultivation of them. They must become habitual. At first the difficulty in clinical observation is considerable; almost overwhelming. Everything in the case appears to be chaotic. The line of demarcation between morbid states drawn in books or in the class-room, appear by no means so sharp at the bedside; signs or symptoms described there as well marked, and which are so to the experienced describer, appear but dimly or obscurely marked to the student, amidst the infinite variety of phenomena which press upon him. There appears to be no interconnection or relation between the symptoms. The mind cannot grasp any leading phenomenon and bring the others into comparison with it, for it knows not which to select as the best; often, indeed, it selects the worst for this purpose, namely, the most general. It is here that the student can be much assisted by the teacher, who, in a few words, or with a graphic touch, can hit off the two or three leading characteristics in the case to be examined. Sometimes a single phrase as "tubercular phthisis," "cardiac dropsy," will suffice to indicate what is to be observed; for the clinical student is supposed to be acquainted with the sciences of pathology and therapeutics, and if not, he certainly ought to be.

The student having thus got a clue as to what he must look for, his examination of the case is much facilitated. His memory, his notes of lectures, or his manual, supply him with the results of the experience of others in a similar investigation; consequently, instead of having to make his way, like the enterprising traveller, over a wide expanse of untrodden wilds, where no beaten track guides his steps, he can confidently pursue the well-accustomed road of systematic semeiology—enabled, with his map in his hand, to mark each turn and winding. What, then, is requisite for him to do in this case? That he shall mark them carefully, minutely, accurately.

FIRST STEP IN CLINICAL STUDY.—The first step, therefore, in clinical study, is to select a well-marked typical example of some common disease, and observe that with book in hand, even to the most minute phenomena. I say of some common disease, because students are apt to run after uncommon cases as the most interesting. An aneurism of the abdominal aorta will attract their attention much more than a case of chlorosis or phthisis. This is undoubtedly a great mistake. A knowledge of the rare case, when acquired, is almost wholly of speculative value, and may be applied once or twice in a lifetime in practice; the knowledge of the other is of daily use.

I do not think, however, that any case will be

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observed with the required industry, minuteness, and accuracy, unless it interests the mind. How, then, can it be made interesting? In this way. Let the student set before him an object to be attained by careful observation. Let him, for example, if well up in his physiology, examine the case with reference to the modes in which aberrations of function take place. Let him take cognisance of the sciential relations of the symptoms to each other. Let him, if he pleases, construct a theory or a hypothesis as to these relations, and seek to verify it, remembering, however, that the theory is of no other use than to stimulate and guide his inquiries. It is not necessary to success to have anything elaborate in the theory or problem to be solved. The simpler, indeed, it is, and the better, as when limited to some simple proposition involving only one or two symptoms. Such an one, for example, as the acid or alkaline reaction of the saliva in the case under observation, under varying circumstances; or the character of the pulse, or of the respiration.

Observation and Deduction Instinctive.—This limitation of the attention to one set of phenomena, is, however, more theoretical than real;

practically it will be found that while apparently it is thus exclusively directed to one set or group, all other *obvious* phenomena have been in fact instinctively noted, and a general picture of the entire group graven on the memory for use and comparison during the remainder of life. This indeed is only an extension to a series of events and objective phenomena, of that fundamental and necessary process of perception by which a written or printed sentence is read, or the simplest experience gained. The constituent elements of the word (the letters), or of the sentence (the words), are never so presented to our consciousness that we note each singly. So it is in the examination of a patient. Experienced tact in diagnosis never analyses; never spells the symptom-letters, or stops at the pathognomonic words, but reads off the case at once, the moment that the whole of the characters become cognisant to the perception. This is the reason why in intuitive diagnosis so few physicians are able to give the grounds of their decision. They are not conscious of the individual elements; no more, in fact, than any man is conscious of the multitudinous points or parts in any merely visual object of which he becomes cognisant, as a book or a chair. It is only the great salient marking points that strike the eye, as the angles and sides of the book, or the seat, legs, back of the chair. What you need, then, for the acquisition of this intuitive sagacity in the perception of disease, is a familiarity with morbid states, having leading characteristics, so that an opportunity is afforded to the mind of instinctively arranging into the proper words and sentences, or into the evolved outlines, if the metaphor may be permitted, all those minute and separately inappreciable phenomena, which reach the consciousness rather as *results* than as *objects* of thought. Then, when afterwards one or two of these leading characteristics are seen, all the rest, although not seen, are known to be there. Just as a single word may be read easily, although all the vowels be left out.

Now, the more readily to gain this familiarity with the leading or pathognomonic characters of a disease, it is better to investigate two or three cases well than many superficially. It will thus be gained in much less time, and therefore at much less cost, and, above all, it will be much more valuable in its results—that is, you acquire a more sagacious, because more accurate intuition. Those of you who enter to the "Examination Class," will, if you please, have special cases committed to your observation and investigation, and thus the opportunity will be afforded you of the kind of clinical training which I recommend.

INSTRUMENTAL AIDS TO OBSERVATION.—Observation by the unaided senses and induction by the unaided intellect, were the only means of research of the ancient Greek school of medicine, and of the era anterior to the revival of learning in Europe. Philosophical research of modern times would be nothing without philosophical instruments of research, as well as a philosophical method. You know well, that in the study and advancement of the collateral or auxiliary sciences, it is absolutely necessary to have aids to the senses. What would chemistry be without the thermometer? What physiology without the microscope? What astronomy without the telescope? Instrumental aids constitute one of the great characteristics of the inductive method. Bacon wisely marks this fundamental need of instruments of research as well as of aids to thought, and embodies the truth in his second aphorism, "De Interpretatione Naturæ."

"Nec manus nuda, nec intellectus sibi permissus multum valet. Instrumentis et auxiliis res perficitur: quibus opus est, non minus ad intellectum quàm ad manum."

I shall consider these aids under the two heads under which they may naturally be classed:—1. The aids to the senses and perceptive powers, or the instruments for clinical observation. 2. The aids to the intellect, or the methods of clinical generalisation and induction. And do not make the mistake to think that this is a useless, because a mere metaphysical division, and therefore of no practical value. More wisely bend your minds to the comprehension of these instructions, however difficult they may be; then, when once mastered, and correct habits of thought and investigation formed, their value will be fully estimated by you. At present I shall direct your attention to the first class only; the other class, namely, the methods of generalisation and induction, I shall reserve for special consideration.

THE CLINICAL AIDS TO THE SENSES.—The clinical aids to the senses and to the perceptive powers are, first, Aids to vision, to hearing, to touch. Those of touch belong principally to the surgical department of medicine. Secondly, Aids to perception, principally of number, space, time, or of the qualities of matter.

Of the aids to vision, the microscope is the chiefest. Clinical research would be hardly possible without it. And this is all I need say now of that instrument, for so numerous are its applications, and so important therefore a knowledge of its uses, that two or three lectures would hardly suffice to set them forth. Clinically it is used principally in the examination of morbid products. Lenses may, however, often be substituted for the microscope. Certain cavities of the body cannot be examined without the means of permitting either light to fall or be reflected upon them. These are *specula*. You have therefore specula for the throat, the ear, the eye; for the vagina and uterus, the urethra, the anus.

The aids to the sense of hearing are, the surgical sound, the stethoscope, percussor or hammer, and pleximeter. These belong, in a technical sense, to the art of exploration by auscultation. The pleximeter (wrongly so-named, strictly since it measures nothing) is used in eliminating sound by percussion upon it, placed over the organs or regions of the body. In hospital practice, the hammer and pleximeter are undoubtedly valuable; indeed, if the patients to be examined are numerous, they cannot be dispensed with. In private practice, and under ordinary circumstances, the fingers of the two hands constitute the best percussor and pleximeter.

The *stethoscope* is an auxiliary to the sense of hearing of comparatively recent application. Perhaps none of these sense-helps have demonstrated more clearly than this the immense value of instruments in the philosophical researches of medicine, and the practical application of the results of these researches to art. It is difficult to conceive how, without it, the precision in etiology and pathology, and consequently in diagnosis and treatment so characteristic of modern medical art, could have been attained. And now, when we see how simple is the principle of its use, namely, the convenient conduction to the ear of sounds made during vital action, it seems extraordinary to us that its value should have remained undiscovered so long. The stethoscope has been made in a great variety of forms. What is requisite is, that the ear shall be well covered with the ear-piece, that all the sounds conducted along the body of the instrument shall reach it; that the opposite end shall fit easily to any surface; and that it be made of good conducting material; hard wood or gutta-percha is the best. Perhaps the double stethoscope may be ultimately a more useful modification than many others; but the great requisite for the right use of the instrument is a trained ear. To secure this, I propose that those who wish to perfect themselves in the use of the stethoscope, and of the other means of physical diagnosis, shall be formed into small classes for practice in the wards, on the evenings of certain fixed days. This plan will secure the *quiet* so necessary to the practice of the art of auscultation, and which is not easily obtained when many are present, however motionless and silent they may keep.

INSTRUMENTAL AIDS TO PERCEPTION.—The aids to perception are those which enable you to measure time and space in relation to structure and function, and to ascertain the qualities of living matter, or of its constituents. The aids to the latter consist in the application of chemical research; of the former, in a variety of measures or *meters*. The height and weight of the body are often taken by standards and scales; the callipers and tapes measure portions of the superficies, and, indirectly, the extent of structural or functional disease below. The amount of respiratory power may be measured variously. 1st, By taking the capacity of the thorax, as indicated by the amount of air respired. These are pulmometers, pneumometers, or spirometers. 2d, By determining the amount of expansion or contraction, or extent of antero-posterior movement of the thorax. Various kinds of "chest-measurers" have been invented for this purpose, having for the most part as the primary element the callipers or the measuring-tape. The rapidity of the respiratory action, as well as of the cardiac movements or the pulse, is measured by your watch or chronometer; the force of the heart by the sphygmometer. The aids to a perception of the qualities, conditions, and composition of vital structures or their products are equally numerous. The thermometer, usually placed under the tongue or in the axilla, gives a definite idea of the varying degrees of temperature of the body, or, placed upon the tongue, of the expired air. The urinometer (a barbarous name) measures the specific gravity of the fluids, especially of the urine; the test-papers indicate their acid or alkaline reaction; and various tests for morbid constituents in the blood, urine, and other fluids of the body, accompany the test tubes. Questions of chemical composition may, however, be sometimes solved by the use of the microscope.

DANGER OF UNDULY ESTIMATING THE VALUE OF AIDS TO CLINICAL RESEARCH.—I have simply and briefly enumerated these various aids to clinical research. I shall not add more now, for to instruct you in the use of each is no part of my present plan. This, indeed, is the less necessary, as excellent manuals of instruction abound. I would rather direct your attention to two errors the student is apt to fall into in the application of them to clinical research, namely, of valuing them too highly, and of pursuing the study of them too exclusively, without continual reference to the great object of his studies, the acquisition of skill and tact in future practice. You may value them too highly, relatively. Consider this point in reference to two of the best of these aids, the microscope and stethoscope. All experienced microscopists agree as to the fallacies to which the use of the microscope inevitably gives rise, unless in hands familiar with its use by long manipulation. And even in such hands, fallacies surely abound; were it otherwise, how can we explain the discordant assertions of the most distinguished microscopists of the day as to the microscopic appearances of morbid structures? The statements made during the successive discussions of the diagnosis and curability of cancer, which were held at the French Academy of Medicine in the autumn of 1854 (*vide* Edinburgh Monthly Journal of Medicine, vols. xix. xx.), sufficiently illustrate the extent of these discrepancies. At one of these (that of Nov. 7, 1854), Velpeau said that a portion of a cancerous tumour had been sent to Lebert for microscopic examination. He, finding no cancer-cells (theoretically so called), in the morbid structure, pronounced it benign. The disease recurred; in the second tumour then formed, the so-called cancer-cells were discovered. Now, as to Lebert's title, beyond most men, to give a confident opinion upon any point of pathological histology, there can be no question; how strongly, therefore, are we warned, by such an occurrence, as to the danger of too exclusive a reliance on microscopic researches. To shew this point more strongly, I subjoin the following quotation from Lebert's "Pathological Researches," published in 1847:—

"Before we began the study of pathology by the microscope, we were engaged during several years in microscopic researches on various questions of Natural History. Yet for all that, a long apprenticeship was requisite before we could form true and exact opinions on the microscopic constitution of certain morbid products. . . . . Pythagoras required a five years' silence from his disciples before they expressed an opinion upon his doctrines. We would recommend to those physicians who propose to use the microscope in the study of diseased products, to keep silence for at least some years before they publish their researches."

These remarks apply equally to the stethoscope, although in a less extensive way. Every one knows how long a time is required to train the best ear to that detection of delicate degrees of tone which is requisite to the reliable use of the instrument, in the diagnosis of the more obscure forms of structural disease; and how signally the best stethoscopist sometimes fails, even in cases in which unaided but experienced observation triumphs.

The second error is that of pursuing the study of these aids to research too exclusively. Tact consists in the prompt as well as accurate detection of diseased states; it is, therefore, incompatible with a slavish dependence upon these various aids, for the obvious reason, that to use them occupies time. Further, in the daily routine of a busy professional life, occasions will often arise when their use is impracticable. Delay may be dangerous; the patient may object; the clothing cannot be removed for physical exploration; the fluids cannot be obtained for chemical or microscopic inquiry; or if obtainable, the microscope and chemical apparatus may not be at hand. Ordinary professional life has various aspects. Every man is not equally qualified by natural gifts; there must be a quick eye and a delicate ear. But the eye and ear, however good naturally, and however well trained, may and do fail with age, although the intellect be still clear. Nor are the conveniences of infirmary routine the lot of the practitioner. That may be cast in the country or in the town; in general or in consulting practice; in a newly-settled country, with few appliances, or amidst the accessible conveniences of British civilization. None of you can tell what is before you. You must, therefore, be prepared for any fate. By far the greater number of you will necessarily have to meet the varied exigencies of general practice, and these, for the most part, are incompatible with much instrumental research.

NEED AND MODE OF STUDYING PHYSIOGNOMICAL DIAGNOSIS.—Now, to meet every exigence successfully, and to be armed at all points, you must, as far as practicable, be independent of these aids, and yet be able to profit by them so as to determine, with reasonable accuracy, the essential points in the case before you. How is this to be done? I would recommend this procedure. Now that you have an opportunity, study well the physiognomy of disease—that is to say, all those external characteristics in the patient that reach the unaided senses, and which are associated with morbid states, whether they be sounds, or odours, or visible and tangible modifications of form, complexion, expression, and modes of functional activity; taking cognisance of minute modifications as well as of the more obvious, for they are only minute in a popular sense. Technically, a shade of tint of the skin, a quickly passing change in the expression, an almost imperceptible modification in the breathing or mode of speaking, the ring of a cough, a local, and in itself trivial development of a capillary network, a slight twitching of a muscle or a tremor, may be as clearly significant of structural disease, as the most characteristic and undoubted physical signs. While, then, you study physical signs, note and compare the corresponding physiognomical characters. While you catch every symptom presented to the unaided eye, or ear, or hand, sedulously seek to connect them, as far as you can, with the physical signs you observe by means of aids, and with the pathological changes revealed by the interpretation of those signs. So that ever after, during your subsequent career, when physical exploration may be impossible, the visible and external phenomena may be associated with the hidden and internal changes, and thus a complete view of the morbid state be attained, independently of the mere aids to research.

PHYSICAL AND PHYSIOGNOMICAL DIAGNOSIS SHOULD CORRECT EACH OTHER.—There is another advantage secured by this plan of observation; you can use the one class of characteristics to correct the inferences deduced from the other. Mere experience, based on rational signs alone, is by no means trustworthy, and will too frequently lead you into error. Physical diagnosis, whatever theoretical ideas of certainty may be excited by its inappropriate name, is but another form of experience, and has its fallacies also. Often has this method betrayed the confidence of those who have relied upon it, to the exclusion of the more comprehensive and surer (albeit less definite) help to be derived from physiognomical diagnosis. Looked at as the exponents of structural or functional changes, the external or physiognomical signs of disease are, in fact, as much physical as those to which that term is exclusively applied. To enable you to understand these better, I will give a short summary of them.

PHYSIOGNOMICAL DIAGNOSIS OF MORBID CONSTITUTIONAL STATES.—There are certain general morbid states, or predispositions to morbid states, which may be determined with sufficient accuracy for therapeutical purposes by certain external characteristics. Practical medicine recognises temperaments, diatheses, cachexiæ, and constitutional conditions, however pathology may ignore them. These give a special character to a multitude of local diseases, so that the general condition being known, the local state is intelligible. Knowledge like this constitutes a kind of intellectual microscope, for it reveals morbid changes in the living body utterly beyond the reach of the optical instrument. To what an extent this diagnosis is practicable in diseases (to mention examples), arising in arthritic, strumous, or syphilitic constitutions, is well known to the practitioner. But that which is of still greater importance to know, is that the knowledge which we possess of the diagnosis and general treatment of these morbid states is often more accurate than of the diagnosis and treatment of the so-called local diseases. So that even when we fail to diagnose these latter accurately, we can nevertheless still administer suitable remedies; inasmuch as that which suits the cachexia will suit also the local change dependent thereon, although its exact nature may be unknown. Thus it is, that for each of the numerous varieties of local disease in an arthritic or strumous constitution, cod-liver oil or colchicum may be equally applicable as a basis of treatment. The great and manifold uses of this kind of knowledge must be obvious to you; I shall not therefore apologise for pointing out to you at length the external characteristics of these general morbid states.

NECESSITY OF PHYSIOGNOMICAL DIAGNOSIS TO DETERMINE THE MORBID CONDITIONS OF THE BLOOD AND VISCERA.—But in addition to what may be termed these innate or congenital tendencies to disease, there are general morbid states superadded to them, or induced by various causes, which also stamp local diseases with a special character, or give them a wider meaning. To these belong various conditions of the blood—all the *hœmic* diseases; general morbid states of the nervous system; and diseases of important viscera, as the lungs, heart, liver, kidneys, uterus, ovaria, gastro-intestinal canal. The blood is variously coloured in various diseases, so that these variations in colour manifested through the capillaries of the skin (changes in complexion, as they are termed) become important signs of disease, and may be connected with miscroscopic and chemical researches into the pathology of the blood, and with methods of treatment founded upon those researches. So that the naked eye can thus be fitted with a microscopic perceptive power. The modes of breathing, and the attitudes of the trunk, are exponents of thoracic disease, but so also are changes in the colour of the blood, or in the facial capillaries themselves. The play of the facial muscles in abdominal disease, as well as the expression of the eye and of the countenance in affections of the nervous system, are keys to the diagnosis of groups of diseases, and are as significant and useful in their way as any merely physical signs, while, at the same time, they are of much more comprehensive import. I shall therefore indicate to you as briefly as I can in another lecture the external characteristics of this kind and their interpretation, just as you learn in manuals of physical diagnosis the characters and interpretation of physical signs.

THE OBSERVATION OF THE ORDER OF SUCCESSION OF PHENOMENA THE FOUNDATION OF ETIOLOGY.—But let me not forget another matter for consideration, and remind you, that when you are inquiring into the pathological condition of a patient, it is only with the greater object of attaining to a knowledge of the *etiology* of the disease. Etiology or the science of the causes of disease, is nothing more than a knowledge of the order of successive development of morbid phenomena. The structural or functional changes upon which the symptoms depend may be revealed to you by physical diagnosis, and by all the admirable aids to the discovery of such changes which modern improvements afford, but you cannot rest satisfied with such knowledge. You must advance another step in the order of causation, and seek to know what is constantly antecedent to or precedes the structural or functional changes discovered. The importance of this knowledge to therapeutics is matter of daily experience, and is embodied in the maxim, remove the cause and the effects will cease. Now by removing the cause is meant simply, interrupting the order of the morbid phenomena, or breaking a link or links in the chain of causation. To do this with tact and skill implies a quick perception of the results of what are termed causes, that is, of the origin, and progress, and ending of the great series of morbid phenomena with which you as practitioners will have to deal. I shall designate this technical perception *etiological diagnosis.*

ORIGIN AND ORDER OF ETIOLOGICAL PHENOMENA. Let us examine for a moment how these etiological series arise, and go on with a view to classification and inquiry. In the first place, we must note that there are a number of agents, to speak metaphorically, which act from without—changes in the temperature, climate, habitations, clothing; in the articles of food and drink, as regards quality, quantity, or fitness; changes depending on the occupation or mode of life of the individual, that is, whether it be active or sedentary; in the open air or within doors; requiring great exercise of the sensorial or of the muscular system; the exposure to noxious agents, and the like. Practically this kind of knowledge is as essential to treatment as that which may be termed diathetic, and for the same reason, namely, because prevention or cure often depends mainly upon the withdrawal of the individual from the causes of the disease. How would it be possible to cure a lead-neuralgia, so long as the sufferer, in virtue of his occupation, is being continually exposed to the poison? How cure a disease dependent upon alcoholic poisoning, so long as the patient is drunken?

Now it is an element in practical tact, to be able to eliminate the phenomena according to their causation; to this end a knowledge of the changes induced in the external characteristics, by various general or special causes, is of some importance. Patients are apt to deceive the practitioner. They are ashamed to detail their follies, or to reveal their secret vices, as manustupration, drunkenness, sensuality. But these vices reveal themselves to the practised medical eye. Or it frequently happens that patients are little aware of the value of the facts or statements which regard themselves; for they may have been insensibly, and therefore unknowingly subjected to injurious agencies. It is a valuable tact to detect the operation of these agents by their less obvious results on the organism, or by a consideration of the occupations, amusements, or pursuits of the patient.

OBSERVATION OF THE NATURAL ORDER OF VITAL PHENOMENA.—Let me pass on to another branch of etiology, namely, to that branch of causation which considers the phenomena that arise in succession *within* the organism, and according to fixed and determinate laws. In health, and therefore not less in disease, one change leads necessarily to another, whether the change be in development or in functional activity. Birth is followed by successive dentitions and by puberty; then mature life, with the reproductive organs vigorous, occupies a certain period, and next comes decline. Each sex has its peculiarities, as well as each age; and mingling with these are the varying influences of the circling hours and seasons. Disease has also its periods; so that it is absolutely necessary to etiological diagnosis, and equally I may add to *prognosis*, to know what is the natural order of events, and be able to apply that knowledge to practical uses. Here medical science presents a large gap or hiatus. We know something of the alternations sleeping and waking; of the menstrual period; of the periodical influence of night and day, and of the seasons. Nor are we altogether ignorant of the morbid changes to which each age and sex are liable at different ages, and the like. We know, too, the periods of several forms of fever, such as the exanthemata and the intermittents. Little of this knowledge, however, has as yet entered the domain of physiological science, and even as to pathology and prognosis, the general, or at least the accepted knowledge of critical days is hardly more applicable to clinical medicine than in the time of Galen. We had yesterday presented to us in the wards of the Infirmary an illustration of this doctrine of critical days, in a case of pneumonia. A woman attacked with rigors on the 1st instant, has remission of the phenomena on the evening of the 7th, and sleeps; presenting, as a consequence of the change, a marked improvement on the following morning. Now Traube, a recent writer, gives the following aphoristic summary of his clinical observations as to the periodic phenomena of acute diseases. "If in acute diseases the abrupt sinking of temperature, leading to recovery, begins, as it generally does, within the first fortnight, then it is always either on the 3d or 5th, or 7th, or 9th, or 11th day that this occurs." This aphorism is so similar to some left us by Hippocrates, that it might be readily mistaken for one of his. How important, at the bedside, is a knowledge of the natural course of disease may be easily comprehended. By it you may alike anticipate the exacerbations or the termination of disease. To what fallacies in therapeutics an ignorance of these laws of sequence leads, is now becoming better known. It is this knowledge, also, which teaches us, that if there be any disease for which a multitudinous array of remedies are recommended as having been found successful, we may conclude it is either a disease of the nervous system, amenable to the stimuli of hope and suggestion, such as epilepsy; or else a disease of the blood, as variola or pneumonia, which usually terminates in health as its natural and necessary termination.

BEARING OF GENERAL TERMS ON THE OBSERVATION OF ETIOLOGICAL PHENOMENA.—Seeing the importance of knowing the order in which phenomena occur and recur, I shall give you a few rules so as to facilitate the observation of these periods in disease. But I must first strongly impress upon you that the age, sex, occupation, and habits of the patient, are not to be noted merely as a matter of course; a clear and distinct appreciation of the etiological bearing which the collective phenomena indicated by the word have on the morbid conditions, is of vital importance to diagnosis and treatment. Under "age" is included a large number of special physiological facts; under "age" and "sex" a number equally special and fertile. Very often your various diagnoses, nosological, etiological, and therapeutical, as well as your prognosis, will mainly turn upon a consideration of the phenomena included in these collective terms. The order of succession of morbid phenomena, that is, of occurrence and recurrence, is illustrated by the doctrines of periodic vital changes and of critical days. These shall have a special notice, for I know of no work in which they are explained in a sufficiently comprehensible, and, at the same time, comprehensive way.

# LECTURE III.

## METHODS OF CLINICAL EXAMINATION.

INTRODUCTION.—It will be useful to recapitulate your objects in clinical observation. You wish to ascertain—

1. The existing morbid condition, the disease: Nosological diagnosis.

2. The pre-existent morbid conditions, latent or actual: Etiological diagnosis.

3. The course and termination of the disease: Prognosis.

4. The method of treatment: Therapeutical diagnosis.

You propose to attain these objects, 1st, By inspection of the patient, so as to read and interpret all the perceptible characteristics of the disease. 2d, By the patient's history of his case elucidated by cross-examination. 3d, By physical exploration of the various viscera, so far as the results already obtained may require. 4th, By microscopical and chemical investigation of the secretions and morbid products.

FIRST GENERAL INSPECTION OF THE PATIENT.—On approaching your patient for the first time, you will rarely be ignorant of the *age*, the *sex*, and the *duration* of the illness, that is, whether acute or chronic; and you will, by looking at the face and person, see at once the characters of the complexion and the expression, the state of nutrition, and the mode of breathing. In other words, you will learn in outline the condition of the blood, of the nervous, respiratory, and circulatory systems, and of the nutrient energy. These data will also enable you, from the first, to limit your inquiries to a class of diseases. If, for example, the patient is a child, it will have a disease of childhood, and not of the parturient state, or of adult life or old age; if the disease be chronic, you exclude all fevers and acute diseases; if the face be wasted, or the complexion cachectic, then you may have a blood-disease to treat; if of a strumous character, it may be a tubercular disease. The tone of voice, the cough (if heard), will direct your attention to the respiratory organs; distortion of a limb to the nervous system, etc. So that at the first glance of your patient you have already made a decided advance in your diagnosis.

FIRST GENERAL EXAMINATION OF THE PATIENT. After this general but rapid survey, a more minute examination follows. The patient (we will suppose he is a man) will perhaps offer you his hand. You may derive information from this. The grasp may be weak and uncertain, and the limb tremulous. This condition indicates an affection of the motor portion of the nervous system, and you will rapidly glance at the face to see if there be distortion, or listen to his greeting to observe if his speech be hesitating; or you will feel the hand, and ascertain whether it is wasted, or hot, or dry, or wet with perspiration, or fat, or large, or rough, or smooth, and the like. The manner in which the hand is offered will tell you something of the mental character of the man you will have to deal with, while its condition will equally tell you something of his past habits and occupations. There is the rough hand of manual labour; the soft hand of the shopkeeper or merchant; the graceful hand of the gentleman-born; the fat hand of the drunkard. And do not think these hints trifling;

in clinical observation every minute particular is to be noted, and you cannot begin too soon. Begin, then, your observations with the hand as well as face, if the opportunity be afforded; *ex ungue leonem;* it may give you a clue to the whole case.

But this, as well as all other similar means of observation, should not be practised exclusively on the sick. You should accustom yourselves to note all the peculiarities of this kind in persons in health that come within your notice, and the relation of the *notanda* to the characteristics of the individual, of whatever age, sex, condition, habits of life, etc., he may be. Many persons can repress their emotional acts, alter the tone of their voice, and deceive you in various ways; but the phenomena I have just mentioned are rarely selected for deception, so that the information you obtain from them is often more trustworthy than that derived from the expression, or manner, or positive statements of the patient, and may, therefore, prevent you falling into error.

The manner of the patient is often flurried at first, and the pulse quickened from the emotional feelings of the moment. This should always be remembered, and time given for the feelings to subside. In the meanwhile, you will glance rapidly over the features, and as soon as courtesy or convenience will allow, have your patient placed with his face to the light, while your back is turned to it. This arrangement will not only prevent him watching the play of your features (a thing the sick are very apt to do in consultation with their medical adviser), but will enable you to scrutinise his more effectually, without attracting his attention to your proceedings. The better to secure this point, you should, if possible, occupy his mind with some indifferent thing, no matter what. Four or five minutes well used will suffice to put you in possession of all the more obvious external characteristics of the case; indeed, often in active practice, two or three minutes can only be afforded for this purpose.

CLOSE OF FIRST GENERAL EXAMINATION AND FORMATION OF FIRST THEORY.—You will now have guessed or learnt the age and occupation of your patient; noted his diathesis, or cachexia; his complexion, or the colour of his blood; the form and play of his features; his attitudes and movements; his mode of breathing; the colour of his lips and the like; and you will have formed already a general opinion or theory as to the disease you have to encounter. The remainder of your examination and inquiry will be directed to the confirmation or rejection of this theory. If further inquiry prove it to be erroneous, you will form another; and if that be rejected, another, until you have satisfied yourself as to the morbid state, or come to the conclusion that you must suspend your judgment until you get additional facts, or try the effects of remedies.

But you have as yet hardly spoken to your patient; all your facts have been objective; you now speak to him, and ask him a few general questions; his own opinion of his case, his occupation, whether married, how long he has been ill, or where he suffers; or else, seeing where he suffers, you state the fact interrogatively. This should be done, however, with caution, and in those cases only in which you can speak *positively*, for a mistake will give an unfavourable impression, and put you in a false position. You have now a more definite idea as to the seat of the disease, and as to its nature, that is, whether it be chronic or acute, and the like.

HISTORY ELICITED, AND CROSS-EXAMINATION THEREON, OF THE PATIENT.—The next step is to elicit the history of the morbid state. This is easy. Patients in general, if mentally competent, have a great anxiety to detail their ailments from the beginning. All you need do is to listen attentively to the story, only asking a question now and then, when the statement is doubtful or imperfect, or required to clear up a deduction already made. An important preliminary inquiry, and to be carefully made, if the case be one of acute disease, is, whether, previously to the attack, the patient was in good health or not. The result will indicate whether it is a relapse, or an intercurrent attack or not; and consequently, whether there be disease of one or more viscera already pre-existent. These questions should be as few as possible, and therefore pointedly direct. Nothing gratifies patients so much as attentive listening; if they become wearisome and prolix, they can be readily stopped by asking them to shew the tongue; this step being followed by appropriate questions. While the patient is speaking, you need not be idle. You can now study more minutely and carefully the various external characteristics I have already alluded to; you can analyse the tone of his voice; his manner of speaking or of breathing; the corporeal as distinct from the mental expression of his countenance, or lines of physical suffering, etc.—constantly the while comparing and associating the facts of his history with your acquired knowledge, and with what you have observed and concluded already. The patient having finished his history, you can now proceed to ask him questions. Practically, by this time, you have attained to a tolerably definite opinion of his case. It only remains for you to verify that opinion by eliciting, in cross-examination, any additional facts necessary thereto. In the meanwhile, you can look at the tongue, feel the pulse, examine the state of nutrition of the system, and make such investigations as can be carried on without aids.

ORDERLY EXPLORATION OF THE FUNCTIONAL AND STRUCTURAL CHANGES OF THE VISCERA.—The cross-examination being finished, you next proceed to an orderly exploration of the condition and functions of the viscera directly or indirectly implicated. This is the most important part of the inquiry; for the result of your observations will be the completion of your nosological diagnosis—that is to say, you will determine the classification of the case, positively and finally (if possible), with a view to treatment, or the exercise of your art.

THE METHODS OF INQUIRY AND EXPLORATION EXAMINED.—There has been a good deal of discussion as to the methods to be followed in clinical inquiry, and I will here notice the principal. They are essentially of two kinds, the artificial and the natural. As to the artificial, the methods are two, the synthetical and analytical. The synthetical, called also the genetical and historical, begins the inquiry with the birth of the patient; includes the health of his relatives and ancestors, so as to trace his hereditary diseases; passes in detailed review the affections of his infancy and childhood; inquires into his social position and occupation, his bodily constitution, his usual morbid states, mode of life, personal habits, inclinations, and idiosyncrasies. This constitutes the first part of the *anamnesis* or medical biography of the patient. The second part ascertains the history of the existing affection, the mode of its commencement, its course, and the operation of the remedies already used. The entire anamnesis being concluded, the present condition of the patient, or *status præsens*, is investigated. In this, an inquiry into the structural condition of the viscera and their functions, each in succession, is carried out in a regular and systematic manner.

The synthetical method is the opposite to the analytical; it commences with the inquiry into the *status præsens*, and endeavours to ascertain the predominant changes of structure or function, and the phenomena subordinate thereto. The result of this inquiry is taken as a starting point for conducting the anamnesis, which, instead of commencing with the history *ab ovo*, goes backward from the *status præsens*. It is a retrospective research.

REASONS FOR PREFERRING THE NATURAL METHOD. The natural method is that which I would recommend for your adoption. I call it the natural method, because it is the method adopted instinctively by every man in his inquiries into the unknown. It is based upon simple observation of the phenomena, and comparison of them with one another, and with the knowledge which the practitioner has acquired of similar phenomena, either by instruction or experience. This comparison leads to the results instinctively aimed at, by a continuous succession of corrected theories, that is, corrected by observation and research—the results themselves being a knowledge of the causation or order of the phenomena, and of the means for their modification, that is to say, the treatment.

Of the respective merits of these methods much may be said. The synthetical may be considered the most scientific and the most applicable to pure pathological research. But it has the disadvantage of not being practical, that is, applicable to the requisites of daily professional life. It is comprehensive in its scope; but it sweeps up much that is useless in therapeutics, occupies much time, and implies great labour. The analytical has the same disadvantage as the synthetical in the latter respect; but this in addition, that there is no guide as to what should be observed and looked for in examining the *status præsens*, so that all the phenomena are presented with equal force to the mind; there is no centre of crystallization for the ideas, and without such centre, important phenomena may be left out. The natural method is free from these disadvantages. It equally requires the observations to be minute, careful, extensive, but is free from vagueness, for it is orderly as well with reference to the inter-connection and meaning of phenomena, as anatomical contiguity of parts. It comprises also the etiological and therapeutical diagnosis as well as the nosological—an important requisite for a practical method, when we remember that no two cases are exactly alike.

THE NATURAL CLINICAL METHOD ANALOGOUS TO OTHER APPROVED METHODS OF INVESTIGATION.—I may add, as a further recommendation, that in establishing the nosological diagnosis according to the natural method, you follow very closely the methods used in investigations in other departments of knowledge. It is analogous, for example, to the method of the naturalist. Diseases are practically arranged by nosological writers into natural orders, just as plants and animals are arranged, only taxonomical names are not given to them. The diseases of infancy constitute a natural order; the diseases of the brain, known as mental disorders, form another. In another we class the diseases of women; and again, diseases resulting from violence, or consisting in disruption or destruction of tissues, form the large natural order of surgical diseases. In botany you take some leading characteristic as the first step, and you class your plant with the Exogens, or Endogens, or the cellular plants. In zoology you determine whether the animal be vertebrate or invertebrate—bird or mammal; the limitation to one division excludes all the rest. In diagnosis you do the same. A disease of dentition excludes diseases of the puerperal or parturient state; a disease of a strumous character, as tubercular phthisis, excludes the class of intermittent or continued fevers. Nor does the process apply less to etiology and therapeutics. Malarious diseases of summer exclude, in etiological diagnosis, the thoracic inflammations of winter; the group of saturnine diseases exclude those arising from mercurial poisoning. It is the naturalness, then, of this method which proves its value. When I come to speak of the two great methods of scientific research applicable to medicine, the numerical and analogical, I shall shew that in these there are the same fundamental principles in operation as in this natural method of clinical inquiry.

FINAL CONCLUSION AS TO NATURE, CAUSES, AND TREATMENT OF THE DISEASED STATES.—The nosological diagnosis being established, the etiological and therapeutical arise out of it; for diagnosis in this sense is nothing more than determining the similarity of the case under observation to those from which the descriptions in recorded experience are derived. Having made this out, it follows that that experience can be made applicable to the case in hand. To do this, you read it up, noting in what respects, as regards the etiology and symptomatology, the case is closely similar—in what it differs.

Having decided upon your plan of treatment, you have to enter upon another and somewhat different duty—the management and supervision of your patient. I shall, however, defer the consideration of this, as I have still to describe those external characteristics of general morbid conditions, or, in other words, of certain natural orders of diseases, the due estimate of which will ultimately decide your diagnosis, whether it be nosological, etiological, or therapeutical. To this end I will, in the first place, give you a brief outline of the characteristics of the leading diatheses and cachexiæ.

## CLINICAL OBSERVATION OF GENERAL OR CONSTITUTIONAL MORBID STATES.

DEFINITION OF THE TERM DIATHESIS.—By the term diathesis is meant such an innate hereditary constitution of the body that, in the course of the vital actions, there will arise at various periods of life, under varying circumstances, local or general diseases, having a common resemblance, either as to etiology, symptomatology, or pathological anatomy. This may be shewn in disorder of a general process, of which the nutrient derangement characteristic of the strumous and arthritic diatheses is an illustration ; or in disease of a special tissue, as in the nervous or the rheumatic diathesis.

DEFINITION OF THE TERM CACHEXIA.—A cachexia is essentially an actually existent morbid state, and not merely a predisposition or tendency to put on a morbid state. A cachexia may be a diathesis actually developed into disease (as the strumous cachexia). The diathesis may arise out of a hereditary transmission from the parent to the child of the general morbid state, of which the local forms are but secondary manifestations ; on the other hand, the cachexia may be due to circumstances not necessarily derived from the parentage, but often from the etiological conditions of the individual. Cachexiæ differ from diatheses, therefore, in this particular, that they may be acquired. Thus, a temperate man need not necessarily have either the arthritic diathesis or cachexia, for an hereditary taint is required for their development; but intemperance will of itself develop the arthritic *cachexia*, even although there be no traceable transmission. The hereditary strumous diathesis may be transformed into the cachexia by innutrient food, by an impure atmosphere, or by depressing agents; but the strumous cachexia may be developed under the same conditions, although there be no taint traceable to the parent. You have, therefore, hereditary diatheses, but both hereditary and induced or acquired cachexiæ.

GENERAL CHARACTERS OF A DIATHESIS.—The hereditary diatheses are the following:—The arthritic, the strumous, the nervous, the bilious, the lymphatic. Of these, the two latter are the least prevalent in the United Kingdom, and are by no means so well marked as the other. The lymphatic diathesis is in strictness allied to the strumous. All these combine variously with each other, and composite diatheses result.

Each diathesis is a unity—that is, every tissue and organ—the blood and every function—the external configuration and the vital powers—are all in harmony with each other, and constitute together an entire whole. It is necessary, therefore, according to the principles of the natural method, to select prominent or predominant general characteristics, easily observable. The following are perhaps the best for this purpose: 1. The colour of the blood as seen through the capillaries: 2, the development of the heart and vascular system: 3, the conformation of the bones and muscles: 4, the features: 5, the form of the trunk and of the limbs: 6, the characteristics of the teeth, hair, and skin: 7, the state of nutrition: 8, the activity of function: 9, the amount of vital energy: 10, the mental character: 11, the sum of the whole. I will first take for examination the strumous diathesis.

## PHYSIOGNOMY OF THE STRUMOUS DIATHESIS.

THE STRUMOUS DIATHESIS is a defect in vital force, manifested by defective nutrition, imperfect development, and deficient function. Characteristics: As to the blood and the vascular system, we observe that the blood-vessels are thin; the heart small; corpuscles few comparatively, indicated by transparent pallor of the skin; cheeks over malar bones delicately tinted; conjunctiva pearly white. Skin thin, transparent, white. Hair fine, silky, thin; in early infancy immediately after or at birth often dark, close-lying and abundant over the forehead, arms, and back. Eyelashes long, curved, lying close together; pupil dilated, hence a soft expression of the eye. Teeth irregular, projecting, imperfectly enamelled, white, and pearly. Nails elongate and incurvate.

*Bony development.*—Head unsymmetrical; malar bones prominent; frontal rounded and projecting; temples hollow; inferior maxilla projecting; nasal bones unsymmetrical and sunken. *Alæ nasi* and upper lip thickened; mouth large, or, if small, unsymmetrical.

*The form* stunted; chest narrow and long from lateral compression at the summit; ribs flattened and receding from the scapulæ; scapulæ projecting, giving a "winged" appearance; lateral curvature or other spinal curve; keel-shaped sternum; abdomen large and projecting in proportion as the summit of the thorax is contracted.

The *limbs.*—Muscles flabby, soft, imperfectly developed; heads of bones (or joints) large; shafts slender; thick wrists and ankles; fingers thickened and clubby (the Hippocratic finger).

*Skin* irritable, giving off abundant epithelial scales, in the form of furfuraceous deposit. Perspiration copious, acid. *Mucous* surfaces generally prone to relaxation; irritable; and readily giving off mucous discharges.

The characteristics of the functional activity indicate vital energy are below par.

*Digestion* imperfect; appetite capricious and irregular.

*Respiration* feeble, hurried, defective.

*Circulation* feeble; pulse quick; extremities cold; animal heat generally defective.

*Locomotion* feeble; inaptitude for exercise or outdoor amusements; manner listless; apathetic.

*Nutrition* imperfect or vitiated, with tendency to fatty and albuminous deposits.

*Reproduction.*—Puberty delayed; sexual appetite feeble.

*Innervation.*—Nervous system irritable, feeble in tone; mind precocious, but mental powers imperfect, or if good, soon exhausted.

All these characteristics may be present, and yet the state of health of the individual may be normal; the constitution may be feeble, but the health may be good. There is, however, a predisposition to the development of disease, either generally, when the strumous cachexia arises, or locally, when tubercular deposit, or strumous inflammation and its sequelæ may result.

PHYSIOGNOMY OF THE STRUMOUS CACHEXIA.—The characteristics of the strumous cachexia are those of the diathesis, but exaggerated.

Skin more furfuraceous; hair scanty, rough, brittle; nails brittle; teeth discoloured and decayed;

alæ nasi inflamed and swollen; lips thickened, rough, and fissured; lower eyelids œdematous; lymphatic glands enlarged and inflamed.

Abdomen pendulous; thorax more contracted; limbs wasted; joints more prominent.

Respiration hurried; breath acid or fetid; appetite exaggerated or abolished; pulse quick, with feverish heat; muscular debility.

MODIFICATIONS OF THE STRUMOUS CACHEXIA FROM AGE AND SEX.—The local diseases differ in the strumous according to age and sex.

During the period of the first dentition are observed cutaneous superficial inflammations, most usually impetigo, eczema, lupus. During the period of the second, cutaneous abscesses and ulcers occur, with caries of the long bones; these are observed especially of the apophyses.

During childhood, together with tubercular deposits in the pia mater, these are not unfrequently found in the mesenteric or superficial glands; and inflammations of the bronchial and intestinal mucous surfaces, as well as of the skin.

At or after puberty, the strumous are liable to albuminous or tubercular deposit in the lungs and liver ; during middle and old age to a similar deposit in the liver and pancreas—less frequently in the lungs. In this cachexia cancerous deposit not unfrequently takes the place in the aged of tubercle. In women, the ovaria and uterus are the seat of local disease at the decline of the reproductive power—as the lungs are at the commencement of it. No particular complexion predisposes to this cachexia, but it is observed to be most severe and intense in the olive-complexioned.

The strumous diathesis and cachexia abbreviate life ; they are not frequently met with after forty, on account of the infantile mortality they cause, and are therefore most observable in the young.

## PHYSIOGNOMY OF THE ARTHRITIC DIATHESIS.

The ARTHRITIC DIATHESIS is seen under two forms, which, from the amount of vital force in each, may be termed sthenic and asthenic ; or if distinguished by the predominant temperament may be known as the sanguine and the bilious. The common dominant characteristic of both is a predisposition to the undue formation of uric acid, and to congestion, irritation, or inflammation of the muscular and articular sero-fibrous tissues, of the vascular system, of the serous membranes, and of the periosteum.

PHYSIOGNOMY OF THE SANGUINE ARTHRITIC DIATHESIS.—This is the *sthenic* form of the arthritic diathesis. The external characteristics are, as to the blood and vascular system :—Blood-vessels numerous ; heart large and powerful ; blood corpuscles numerous ; skin over malar bones highly vascular, giving a floridness to the complexion. Skin fair, firm, oleaginous, perspirable ; eyes blue ; hair thick, not falling easily ; teeth massive, well enamelled, regular, even, undecayed in advanced life ; malar bones flattened ; head symmetrical ; nasal bones well formed ; nose aquiline or of mixed form ; lower jaw massy ; lips symmetrical.

*Form.*—Figure for the most part tall ; thorax broad at summit ; ribs, well curved ; abdomen full ; muscles firm, large ; limbs large, robust ; gait erect, well-poised.

*Nutrition* active ; digestion vigorous ; appetite great for animal food and alcoholic stimuli.

*Respiration* deliberate, deep ; circulation vigorous ; animal heat abundant ; locomotion active ; aptitude for exercise or out-door amusements.

*Reproductive* powers active ; innervation abundant; the mental powers vigorous and enduring. This diathesis tends to prolong life; it is therefore seen often after forty.

The *predisposition* to disease in the arthritic diathesis may be *general*, and consist in the retention of urea in the blood, or in its too rapid production; or *local*, and consist in inflammation and inflammatory irritation of the products of the serous layer of the embryo, ending in calcification or bony change. When the retention of the urea is associated with a depraved blood-crasis, or with visceral disease, especially of the kidneys, liver, and heart, the arthritic *cachexia* is developed.

MODIFICATIONS OF THE SANGUINE ARTHRITIC DIATHESIS BY AGE AND SEX.—The *general* predisposition to disease in this form of the arthritic diathesis manifests itself variously according to *age* and *sex*. It is shewn most purely and distinctly in males, and at an age when nutrition is most active, and visceral disease at a minimum. In male children, by lithiasis; by eruptive diseases, principally *congestive;* and by an abnormal appetite for animal food; in male youths about puberty by epistaxis, hæmoptysis, and functional cardiac disorder. In middle age by gout;

by hepatic and cardiac congestion; by hæmorrhoids; and often by chronic congestion of cheeks and nose.

The sanguine gouty cachexia may be associated with struma, or it may be typical; the typical form is best seen in advanced age.

PHYSIOGNOMY OF THE SANGUINE GOUTY CACHEXIA. The external characteristics of this gouty cachexia are —blood-vessels largely developed over the malar bones, and varicosed; blood darkly tinted or icteric; skin oily, yellow from subcutaneous deposit of fat, or fatty degeneration of the derma; hair thick and white; teeth numerous, discoloured, crusted with tartar; lips bluish; nose reddish, hypertrophied; margin of lucid cornea opaque at junction with sclerotic (the *arcus senilis*); abdomen pendulous; limbs thick; joints nodose; nodosities on the ends of the fingers, lobes of ears, fasciæ of muscles and tendons; respiration hurried, wheezing; pulse intermittent, irregular; stomach flatulent; digestion acid; urine loaded with lithates. Temper irritable; mind sometimes enfeebled.

The *local* diseases of the arthritic cachexia are principally seen in adult males past the age of forty-five. They consist especially in chronic inflammations of the muscular and articular tissues; in calcification of the basilar and coronary arteries, and of the cardiac valves. These changes give rise to hæmorrhagic apoplexy, angina pectoris, and cardiac hypertrophy and dilatation; and to secondary pulmonary affections, as emphysema, pulmonary apoplexy, and asthma. Irritation of the mucous surfaces is not uncommon in this form of arthritic cachexia, giving rise to nephritis, pharyngeal and laryngeal coughs, diarrhœa, chronic gouty eruptions, knobby fingers, and the like.

ARTHRITIC PREDISPOSITIONS IN WOMAN. — The arthritic diathesis and cachexia, as manifested in woman, have never had the attention they deserve. This omission has arisen from a fundamental mistake in pathology, namely, that they occur but seldom in the sex. They predispose at puberty to hysteria in anomalous forms; to varied neuralgiæ; nephritis; hysteritis; acute cutaneous inflammations; and to vicarious urinary and menstrual discharges.

The arthritic cachexia in the female predisposes to chronic skin diseases, especially desquamative chronic erythema of cheeks and nose; to chronic inflammation of the uterine cervix; and, in the decline of life, to nodose joints and fingers and to rheumatic gout.

PHYSIOGNOMY OF THE OLIVE-COMPLEXIONED ARTHRITIC DIATHESIS.—The olive-complexioned or bilious arthritic diathesis is usually asthenic, and is comparatively of rare occurrence. Its external characteristics are—Blood-vessels few; blood corpuscles an average or below par (oligæmia) no capillary development over the malar bones; complexion tending to olive; hair dark; teeth small; features and limbs small; tendency to *embonpoint;* appetite feeble; circulation feeble; calorific powers defective; hepatic functions imperfect; predisposition to gout at an early age, and in the females of a family as well as in the males; to struma; to tubercular hæmoptysis at puberty; to cataract; atonic gout; to nephria and to chronic purpura at more advanced ages.

ASTHENIC ARTHRITIC DIATHESIS AND CACHEXIÆ. It is more usual to meet with complex rather than the typical forms of the cachexiæ and diathesis just described. The arthritic diathesis and cachexia may appear in an asthenic form, and be characterised specially by a tendency to tubercular deposit, or else by fatty rather than albuminous or calcareous changes in the tissues. The last mentioned may be designated the adipose arthritic cachexia. It is allied in the quality of feeble nutrient action to the strumous diathesis, with which it is sometimes confounded, sometimes complicated. There are two varieties. The one characterised by fatty accumulation, of which chlorosis gigantea and polysarcia are types; the other by fatty deposit in the interstices of tissues, as in those of the heart, arteries, kidneys (fatty degeneration). In both the external characteristics are those of the arthritic diatheses, and in both the ancestral or family taint must be noted. Probably it is the olive-complexioned which presents, comparatively, the larger number of these asthenic types; in this respect there is an analogy between the olive-complexioned strumous diathesis, and it. As to the adipose cumulative form, the external characteristics are obvious enough, namely, corpulence of limbs, face, and abdomen. This is, perhaps, in strictness, the lymphatic cachexia, which I will notice shortly. In the adipose *depositive* form, there are usually evidences of feeble powers. The figure is slight (especially in the olive-complexioned), the pulse weak, the extremities cold; blood vessels are sparingly scattered over the cheeks, and the few there are, not unfrequently become varicose early in life. One tooth in the lower jaw is often seen to be thrust out of rank (a "buck-tooth").

An arcus senilis, probably fatty deposit, occurs at an early period of life — sometimes before forty — and the specific morbid actions are of a low type and metastatic, giving rise to retrocedent, irregular, misplaced, or nervous gout. This form is closely allied to the next I shall mention as belonging to this group, namely, the arthritic tubercular cachexia. The fatty degeneration which characterises it seems to pass readily into the tubercular or cancerous under circumstances favourable to these changes.

PHYSIOGNOMY OF THE ARTHRITIC TUBERCULAR CACHEXIA.—With the taint of gout in the ancestral or collateral line, there are always present some of the leading characteristics of the arthritic diathesis, namely, regular features, well-set sound teeth, and a pearly white and florid complexion. But the lower jaw is usually contracted, the bones of the face small, the skin delicately thin or transparent; the neck elongated; the thorax narrowed; the heart's action feeble and irregular. This is often considered to be a form of the strumous diathesis or cachexia, but it is much more distinctly allied to the arthritic. The characters of the strumous tubercular patient are in strong contrast with those just mentioned. The pupil is more dilated; the nose and lips thicker, the teeth more irregular, more discoloured, and more frequently decayed; the skin more furfuraceous, the smaller joints more clubby. The similarity between the arthritic tubercular cachexia and the strumous consists in the hæmoptysis, which, in the former, is so frequently *followed* by tubercular deposit in the lungs. The cause of this pulmonary hæmorrhage in the arthritic is rather a fatty degeneration of the pulmonary blood-vessels, (at least when it is the earliest symptom) than, as in the strumous, a deposit of tubercle. There seems reason to think, too, that when tubercle is actually deposited in this cachexia it is rather of the grey semi-transparent than the yellow variety. It is found in the air-cells, rather than the capillary bronchi, while deposit in the lymphatic glands is a rare occurrence. All these points distinguish the arthritic tubercular from the strumous tubercular cachexia.

THE ADIPOSE OR LYMPHATIC CACHEXIA.—The *adipose* or lymphatic cachexia is a complex form with both a strumous and arthritic element. Its characteristics are, large bones, largely developed heart and vascular system; early deposit of fat under the skin, in the omentum, the mammæ, the face. With these there is want of osseous symmetry; a feeble muscular power; imperfect digestion; unsound teeth; acid breath, and other strumous signs. The predispositions are to tubercular disease in the early years of life, up to twenty-five; to irregular gout after forty-five. Very often the accumulated fat is suddenly absorbed, leaving the individual thin and lank, or the contrary takes place, and the individual rapidly becomes loaded with fat—both changes recurring in consequence of depressing agencies.

PHYSIOGNOMY OF THE HÆMORRHAGIC CACHEXIA. The vascular or hæmorrhagic diathesis or cachexia is a modification of the asthenic arthritic forms; but there is also an important abnormal condition of the blood itself, as well as of the blood-vessels. It is the hæmophilia of Schönlein. The external characteristics, if developed in individuals of the Teutonic race, are a fair complexion, usually blue eyes, and an abundant capillary development over the malar bones. If in the dark or olive-complexioned, the eyes are grey; the hair black; the circulation feeble. A marked susceptibility of the males of the family to hæmorrhages from slight causes, at all ages, is a marked characteristic of this variety of the arthritic cachexia. Besides this hæmorrhagic tendency, there is a predisposition in youth to spasmodic and neuralgic diseases and to phthisis; in middle age to hypochondriasis; in advanced years to nephritic and gouty pains. Very often struma complicates this form.

There is a variety of this type occasionally met with which is complicated with the nervous diathesis, and is specially characterised by excessive sensorial development. For the most part the complexion is highly florid. It predisposes to arterial neuralgia; to arteritis, with plugging of the artery, and gangrene; and to profuse hæmorrhages from the parenchyma of organs—splenic—gastric—anal—hæmorrhoidal or cerebral—according to age.

All these cachexiæ shorten life.

THE RHEUMATIC DIATHESIS AND CACHEXIA.—Two forms will be observed, the vascular, allied to gout, and the strumous, with external characteristics of struma. In the latter there is no floridness, but pallor of complexion; a predisposition to sero-fibrous, and not to synovial inflammation is observed; to lymph deposits in the vascular system; and to local diseases dependent on arteritis or on travelling lymph plugging the vessels (*embolismus*).

PHYSIOGNOMY OF THE NERVOUS DIATHESIS AND CACHEXIA.—The external characteristics are, medium stature; small muscular development, spare habit; countenance mobile; eye lively; forehead broad and lofty; muscular movements abrupt, jerking, and energetic; the sensorial sensibility is great. This diathesis often constitutes an important element in the other diatheses and cachexiæ, especially the arthritic and strumous; ingrafting, when present, a predisposition to asthenic and anomalous diseases of the nervous system. The especial diseases to which it predisposes, when thus associated, are insanity, anomalous hysteria, eccentricity, oinomania, epilepsy, eclampsia, chorea.

PHYSIOGNOMY OF THE CANCEROUS CACHEXIA.—This may arise in any diathesis or cachexia, but it appears to be most frequently associated with the strumous about middle age or later. The deposit which characterises it usually occurs in organs which are exempt in the earlier periods of life from tubercular deposit. The characteristics are therefore, as to the features, those rather of the strumous cachexia than the arthritic. The complexion is muddy, waxy, or semi-transparent; the venous circulation torpid; the expression of countenance gloomy; the temper captious and melancholic; the muscular power enfeebled; the appetite impaired; the body progressively wasted; the nights sleepless. It attacks middle age.

THE HÆMIC OR BLOOD CACHEXIÆ.—The induced and not necessarily hereditary cachexiæ are hæmic in especial. They are essentially characterised by change in the red blood corpuscles, either as to number, to colour, or to vital force; or by increase of the white corpuscles. Pallor of the surface is a predominant characteristic; but it must be borne in mind, in the estimate of their relations, that they will vary much, according to the age, temperament, diathesis, or cachexia upon which they are superinduced; and that they may occur in any temperament, diathesis, or cachexia. I can only indicate the leading forms.

i. *True Anœmia from Loss of Blood.*—The characteristics are—Pallor of the lips, prolabia, face, hands; tendency to deposit fat; pulse jerking or thrilling; cardiac impulse slapping, palpitating; blowing murmurs, especially in the veins; feeble capillary circulation, indicated by œdema and transient albuminuria; respiration hurried; muscular power feeble; limbs easily aching; sensorial powers feeble.

ii. *Physiognomy of Scorbutus.*—This cachexia arises from imperfect nutrition and aëration of the blood. Characteristics vary as to the stage and intensity. The first stage, most usually designated chlorosis, and may therefore be distinguished as the *chlorotic.* It is marked by a muddy pallor of the complexion; pale gums; languor; hurried respiration; gastric pain and irritation; fœtor of breath. In the second stage (which from its sequelæ may be distinguished as the *rheumatic*), we note a complexion of a dusky, dirty tint; features slightly swollen; spongy gums, soon bleeding; œdema; pains in the limbs. Third stage (*the hæmorrhagic*), leaden pallor; gums purple or livid, fungoid; vibices and petechiæ; hæmorrhages from the mucous surfaces; albuminuria; spasmodically flexed extremities; knees swollen and painful; "bullock's liver," a fungus growth, from wounds.

iii. Of the *glandular hæmic cachexiæ* I note the following:—

*a.* The *splenic* (anæmia), with death-like pallor, and enlarged spleen. Variety, the leucocythæmic or leucohæmic of Virchow.

*b.* The *gastro-splenic* or true chlorotic, with gastric neuralgia.

*c.* The *gastro-hepatic* or *melanchlorotic.*—A combination of splenic spanæmia, with scorbutus.

*d.* The *melancholic*, associated with atrophy of the spleen ? characterised by a deeply sallow or dirty complexion ; pallid lips ; œdema of left leg ; neuralgic pains in left side ; suicidal despondency.

*e.* The *melancholic*, with displacement or irritation of colon ?—Anæmic tint ; despondency ; indigestion ; wasting ; constipation or diarrhœa ; pain in region of colon.

*f.* The *supra-renal?* or "bronzed skin" anæmia. Nails white ; prolabia and mucous membrane of mouth, stained with inky patches ; the face, hands, axillæ, and trunk, variously coloured—either uniformly or in patches of a colour varying from pale yellow to bronze ; the hands and feet cold ; pulse feeble ; a feebly-beating heart ; irritable mucous surfaces ; wasting. This has hitherto been observed as an affection of adult life ?

iv. To enumerate the cachexiæ dependent upon morbid states of the viscera, whether structural or functional, would lead me away into general pathology.

I need only refer, therefore, to the renal, the cardiac, the hepatic, and the onanistic, as illustrations of the general cachectic conditions thus originating, and which are in fact chronic morbid states of an intractable character. There are also various cachectic conditions primarily dependent upon certain poisons, the characteristics of which ought to have your special attention. Alcohol and lead-poisoning are the most common forms, but others should not be forgotten, as those arising from iodine, phosphorus, etc.

I have dwelt at some length upon these cachexiæ, as important *notanda* when taking a case, partly because there can be no philosophical diagnosis or therapeutics without a thorough knowledge of them, but mainly because the information regarding them in our systematic works on medicine is scattered through many volumes, and at best is imperfect. What I have detailed to you is confessedly imperfect too, but it is right to say that it is the result of much careful observation and thought on my own part.

# LECTURE IV.

## ON PROGNOSIS AND ON THE ORDER OF SUCCESSION OF MORBID PHENOMENA.

PROGNOSIS.—After you have established your diagnosis and treatment, you will still have to watch the progress of the disease from day to day, and to manage the case. Especially you will be called upon to state your opinion as to the probable duration and results of the illness. This is that part of the medical art termed prognosis. Prognosis may be based upon simple experience. I gave you an illustration of empirical prognosis in my first lecture, drawn from the aphorisms of Hippocrates. As a fundamental principle of this kind, and of equal antiquity, it may be stated, that the more the countenance changes from its ordinary condition, the greater the danger. The *facies Hippocratica* is a change in the physiognomy, the description of which by Hippocrates is so true to nature, that his name is linked with it for so long as medical literature shall exist. It is well worthy your study in the dying. I will quote the description. "The features have their last degree of alteration when the nose is pinched, the eyes sunken, the temples hollow, the ears cold and contracted, and the lobe turned out, the skin of the forehead rough, tense, and dry, and the colour of the whole face yellow, or black, or livid, or leaden." Or take the following description from the same writer of the carphologia or movements of the hands in typhomania, so prognostic of a fatal issue in fevers and cerebral diseases. "I have made these observations upon the movements of the hands. In acute fevers, in peripneumonias, in phrenitis, and in headaches, the hands moved to and fro before the face, seeking in the void, as if gathering bits of straw, picking at the coverings, or detaching objects from the walls of the room, constitute so many signs of a fatal termination." Now this kind of prognosis, being dependent upon observation and experience, can only be acquired by assiduous observation at the bedside of the sick. It is hardly possible to give general rules. You must acquire this tact in the wards; and you will have opportunities for the acquisition, because so many of the cases admitted are of a serious character, and of necessity terminate fatally.

INSTANCES OF COMMON RULES FOR PROGNOSIS. There are a number of common-sense rules, however, which are deductions from our knowledge, and not the results of our mere experience. Thus we can easily comprehend that in a disease like bronchitis or phthisis, in which there is copious expectoration as an essential part of the affection, a sudden cessation of the process will but be the forerunner of death, inasmuch as we know that the retention and accumulation of the sputa in large quantities in the bronchial tubes will necessarily cause fatal asphyxia. So also we may conclude that a continuous wasting going on unchecked by treatment, in an individual who ought not to waste normally (as in adult life), implies a fatal termination of the disease, whatever it may be, or wherever its seat; for the inevitable tendency of such a state is to terminate in a fatal exhaustion of the vital powers. In like manner, when a disease has resisted suitable remedies at a period when the system was in a favourable state for their due and salutary action, it is not probable they will be more efficacious when the disease is more advanced; but, on the contrary, we may expect less and less favourable results. Many rules like these are deducible from common-sense views of health and disease.

THE FOUNDATIONS OF SCIENTIFIC PROGNOSIS.—But there is a prognosis which may be termed scientific, inasmuch as it is founded upon certain general laws of occurrence or recurrence, according to which distinct series of vital actions, whether normal or morbid, succeed each other at regular periods, that is, after laws of definite duration. This kind of prognosis is well known, and constantly practised in the eruptive fevers; the more especially in them perhaps, because the eruption or cutaneous inflammation is a phenomenon, or a series of phenomena, easily watched and estimated. It is also of great practical value in the treatment of intermittent fevers of every kind, for in these the paroxysm of the fever is usually marked so clearly from its commencement to its termination, that the most superficial observer can hardly fail to note the law of periodic recurrence. In women, in whom there is a general change in the health co-existent with the monthly functional activity of the ovaria and uterus, a practical prognosis, founded upon this monthly nisus, has been in use amongst physicians from the earliest ages. Here, again, in the flow of the catemenia there is a well-marked indication of the periodic change, although practitioners are sometimes led into error by their patients, who do not usually note the flow unless it be coloured. If there be few blood-corpuscles, and little flow, it is popularly believed to be suppressed.

THE SIGNIFICATION, AND NOT THE EXTENT OF PHENOMENA, THE IMPORTANT ELEMENT IN PROGNOSIS.—Now it is a mistake to conclude that there is no periodicity or order of sequence in other diseases, and in other series of vital phenomena, because no very manifest or tangible phenomena indicate the operation of the law of regular occurrence. Phenomena are minute in a popular or relative sense only. The sudden fall of the pulse, in a certain stage of pneumonia, is equally as significant of an important change (a change for the better) in the patient, as the due flow of the catamenia regularly, at each monthly period, is significant of an appropriate change in the system of the individual at that time, and of healthy ovarian action. It is the signification then, and not the extent of phenomena, which renders them important. In this way a sudden and transitory syncope, or a sudden blindness, or a grinding of the teeth, may be much more important in prognosis, than a markedly irregular pulse, a violent palpitation, or a paroxysm of delirium.

In those cases, therefore, in which the phenomena are not extensive, although significantly important, it is an advantage to know when and how to look for them, for thus they will be the more readily detected or observed. I propose to give you this information.

DEFINITION OF A CRITICAL DAY.—And first, as to the critical days, so called, or the order of recurrence of phenomena in fevers and periodic diseases. I define a critical day as that day on which some change takes place in the phenomena of the disease, significant of two things; first—either of death, amelioration, or recovery on that day ; or—of death, amelioration, or recovery on a subsequent day. The change may be from health to disease, as occurs in the onset of fevers; or it may be in the cessation, exacerbation, or development of symptoms in the course of the affection. Such a development as an intense rigor, a hæmorrhage, a diarrhœa; such an exacerbation, as a rise in the pulse from 100 to 130; such a cessation, as the occurrence of sleep after sleeplessness—of a breathing moisture of the skin after feverish dryness—of disappearance of the albumen in albuminous urine, and the like. But the change may not be marked by any obvious symptom: it may only be in the feelings of the patient; he may feel much better or much worse, and nothing more be noticeable; yet this is also a change; indeed, a very important change. All diseases that have a definite period of duration, as fevers; all paroxysmal diseases, all sudden injuries, as wounds; and many chronic diseases, with intercurrent febrile phenomena, as phthisis, manifest a law of periodicity. Their various exacerbations, remissions, and phases, may be therefore anticipated and provided against; or if remedies be given, the action of the remedies may be considered apart from the action of the law of sequence. Now, the first thing to determine in cases of this kind, is the date of commencement of the series, for the detection of the periods will follow upon this.

MODE OF OBSERVING PERIODIC CHANGES GENERALLY, AND IN FEVERS.—There can be no difficulty in the observation of periodic changes in all paroxysmal affections; for the date of the commencement of the paroxysm will be the starting-point of the calculation, unless it is clearly obvious that the paroxysmal phenomena have themselves a relation to some antecedent series, as rigors, sudden headache, or the like. In a case of this kind, each sequence should have a separate notice and calculation, and then the two series should be compared.

The method of counting critical days in fevers, is the following:—Take the day of the first sense of chill, or if that cannot be ascertained, the first day of exacerbation or remission. Then count backward theoretically, and see if the order of succession of any observed phenomena corresponds to the already supposed type, and then observe carefully the symptoms as they subsequently appear. In entering dates in the case-book, place the day of the disease below the day of the month. When a whole family is attacked, note the days in each case very carefully, and in addition ascertain the menstrual or dentitional periods, the date of birth, and the menstrual periods of the mother. Indeed, if possible, these should be ascertained in all cases.

Although as to fevers, the ordinary rule is to date from the first rigor, and not from the occurrence of a mere premonitory phenomenon, as a diarrhœa; yet premonitory phenomena should also have their place in the case-book, and be referred as accurately as possible to the proper date. Subsequently it may so happen, that they will serve as important links in the series of events.

Critical Days in Chronic Diseases.—In chronic diseases, the law of periodicity is rarely so distinctly marked as in the acute and paroxysmal, for the obvious reason, that the changes which indicate periodic movements in the vital actions are from a state of disease to a state of disease, and not of health. I may add, also, that in chronic diseases, the order is not itself usually so regular. From time to time the type will change; as in an ague, from a quotidian, or every-day type, to a tertian, or every other day, or every fourth-day type, and back again; so that without careful calculation, as well as observation, there may be nothing but confusion apparent.

Observation of Longer Periods.—The preceding remarks apply to critical days in the ordinary sense of the term. But there are periods which recur at intervals of weeks, or at intervals which are multiples of weeks, such as is the menstrual period; or at intervals which are multiples of a month, as the periods of utero-gestation, of dentition, of recurrent insanity, and other affections of the nervous system.

THE MENSTRUAL PERIOD.—1. This is the typical form of the twenty-eight day or monthly period. In women it should always form an important point of observation; it may be taken, indeed, as a starting-point in the greater proportion of cases. It is usually indicated by the occurrence of the principal and most obvious phenomena, the sanguineous discharge; or, when this is suppressed, it can be calculated retrospectively or prospectively from the last appearance of the discharge. And this is an important principle, for the mere suppression of the more obvious characteristic must not, by any means, be taken to indicate that the entire series of physiological changes in the blood, the nervous system, and the ovaria, are suppressed too. They may, on the contrary, be only the more important, because occurring in deviation from the healthy manifestation.

The monthly period occurs in males as well as females, and is occasionally indicated even in them by hæmorrhagic discharges, as epistaxis, hæmoptysis, hæmatemesis, hæmaturia, and hæmorrhoidal flux. Most frequently, however, the law is shewn in the monthly return of paroxysmal diseases of the nervous system, of which epilepsy is the most common.

The monthly period is simply a multiple of weeks; it may be therefore shortened or lengthened just as the menstrual period. The most common modifications are into fourteen and twenty-one days, and multiples of them, as six weeks, two months, three months. Utero-gestation and the parturient state will afford you illustrations in women, as well as paroxysmal affections in both sexes. I may add, that all febrile and inflammatory affections of the parturient state are ruled as to their exacerbation and decline by critical days. In making a calculation, the fact should be noted, whether the term of utero-gestation is a normal multiple of weeks, and whether the commencement of labour was a natural or an unnaturally induced process. If the latter, the calculation as to the periods should be made from the last normal catamenial flow.

Dentitional Periods.—During the three dentitional periods, but especially during the first and second, there is a law of periodicity in operation, not dissimilar from that which regulates the action of the ovaria when puberty is established. This is shewn by the recurrence of convulsions, diarrhœa, and the like, as well as by the eruption of the teeth at multiples of the weekly or monthly period. The careful observation of the operation of this principle will be occasionally found of much value in the diagnosis, prognosis, and treatment of the diseases of infancy and childhood. For practical purposes, each eruption of a tooth may be considered as analogous to a menstrual period, so far as the *general* health is involved; that event may, therefore, be calculated from both, prospectively or retrospectively. During the third dentition (the eruption of the *dentes sapientiæ*), we have the completion of puberty. At this period, the physiological phenomena are very different from those of infancy and childhood, and consequently the pathological phenomena are very different also; but the seat of the principal phenomena, the nervous system, is the same. Hence the occurrence of functional diseases of the nervous system, especially in women, at this age. The more important modifications in the health are due to the action (regular or irregular), of the ovaria and testes, as in hysteria.

THE RELATION OF CRITICAL DAYS TO THE WEEKLY AND MONTHLY PERIODS.—The critical days in fevers are submultiples of the week; they differ, just as the disease may be of a tertian or quartan type. For practical purposes, the 4th, 7th, 11th, 14th, 17th, 20th, are the most important; but of all, the 7th and 14th. They occur in a large number of acute and chronic diseases, but are marked with much more distinctness in some than in others. Thus, the tertian changes in a case of phthisis require aids to observation to detect them; the patient must be weighed daily; the amount and character of the urinary excreta noticed, etc. In an ordinary case of quartan ague, running on for several weeks, the paroxysms require nothing more than simple observation. Occasionally the types will occur alternately at regular periods. As, for example, there may be a quartan type for a definite number of weeks, then a tertian type may come in and continue for a period; or, what is not unusual, there may be definite periods of health alternating with paroxysms at tertian, quartan, or other periods.

THE DISEASES CHARACTERISED BY PERIODIC CHANGES.—The following are the diseases in which you may observe critical or periodic changes:—

Primarily and eminently the malarious, or diseases caused by marsh miasm; that is, fevers of the intermittent class, and all forms of disease in which marsh miasm exercises a predominant influence, as intermittent neuralgiæ, and other similarly periodic affections of the nervous system.

Inflammatory fever, following on mechanical injuries.

The entire group of the exanthemata.

The groups of fevers dependent upon a specific cause, the operation of which is progressive, and occupies time, as exanthematous typhus, whether Irish, petechial, miliary, or pestilential; influenza; relapsing fever; erysipelas; the intercurrent febrile attacks in the leprous and syphilitic cachexiæ; hydrophobia; tetanus.

The excretory fevers, as acute gout, rheumatic fevers.

Inflammations traceable to any of these fever-poisons, as herpes zoster; acute pemphigus; also various forms of pneumonia, pleuritis, bronchitis, nephritis, diarrhœa, hysteritis, inflammatory dyspepsia, and cutaneous inflammations, occurring as intercurrent or secondary diseases.

The critical days are not well marked in the ochletic and miasmatic or sewer-poison fevers, or in the intermittents that have changed into the continued type; but the day of death, or the occurrence of a favourable or unfavourable change, is often on a critical day. In the various forms of fever in which intercurrent visceral inflammations constitute important complications, or in which there is great devitalization of the blood, the order of the phenomena is apt to be set aside, and death either occurs quickly, or the natural termination is delayed. This explains the conflicting statements of observers as to these points, one of whom (Dr. Latham) makes out that more than one-third of his total number of cases of fever were prolonged beyond the twenty-eighth day; and of these so prolonged, one-third were prolonged above six weeks. In instances of this kind the *sequelæ* of fever are surely confounded with the essential condition itself, which is rarely prolonged beyond the twenty-first day. It is in pestilential fevers (as plague, yellow fever, cholera) that death is too early for the manifestation of the regular periods of the fever. Should the epidemic be mild, then these are seen. Indeed, this circumstance alone renders the etiology of fevers a difficult question for investigation, giving rise to a sub-acute instead of a per-acute type. In well-known fevers, as the variolous, we know how widely individual cases will differ. Analogy would teach us that this varying action of the poison occurs also in influenza, typhus, yellow fever, and plague; indeed all the pestilential forms.

OBSERVATION OF METEOROLOGICAL INFLUENCES. I have said nothing of those periodic influences, which, being primarily or secondarily atmospheric in their origin, influence the course of vital phenomena by direct action on the organism. The presence and absence of the sun's rays corresponds to the time of waking and sleeping; and these states again influence in a very important manner the accession, exacerbation or remission of disease. Changes in temperature, both diurnal and annual, occurring in consequence of changes in the sun's place, together with the barometric, electrometric, and hygrometric variations following thereupon; the seasonal sweep of aërial currents, as winds, and even telluric changes, have all their influence; sometimes counteracting all treatment, sometimes developing disease with fatal rapidity, and not unfrequently giving a fatal character to diseases, which, under more favourable meteorological conditions, are for the most part very mild. Meteorology, in its practical applications, is as important to medical art as to agriculture or navigation; and no practitioner is complete in practical tact without a knowledge of these applications. At present, however, I can only state a few general facts.

Observation of Horary Meteorological Changes.—The hours of the twenty-four in which pathological and physiological changes take place are, in the order of their importance—

*a.* From 4 to 6 A.M., when the consumption of oxygen by the organism is at the *minimum;* the thermometer low; the atmospheric pressure low. Death is most frequent at this period; and attacks of epidemic cholera, diarrhœa, ague, and the like, most likely to occur.

*b.* From 8 to 10 A.M. are favourable hours for the health, and the opposite, therefore, to the early morning hours.

*c.* The night hours are appropriate to sleep; and it is during these that diseases seated in the nervous system, or originating there, are the more frequent. The hour of falling asleep is marked by a state of the sensorial system closely analogous to that of morbid states; there is a quasi-delirious condition, predisposing to those paroxysmal diseases, which are usually associated with an abnormal circulation of the blood through the brain. It is at this hour that delirium begins in fever and insanity, and that epileptic attacks occur.

*d.* The hour of profound slumber, usually from 1 to 2 A.M., is also characterised by a state predisponent to paroxysmal diseases, but more especially to those in which interrupted excretory function acts on the nervous system; to this group spasmodic asthma, the spasmodic neuralgiæ, and gout, especially belong.

OBSERVATION OF SEASONAL CHANGES. — The seasons exercise an influence in various ways upon the progress and treatment of disease. It is to be regretted so little information is afforded by systematic or text-books on this point; we want, in fact, a system of medical meteorology. I can at present only request those of you who attended my winter course on the Practice of Medicine, to recal to your remembrance what I then said. I may here state generally that you have compound influences to consider. There is an inner annual revolution in the vital phenomena of animals, especially of the vertebrate class, which is almost, if not wholly independent of the seasons, and which, like that of sleeping and waking, follows rather the law of successive activity and repose than of meteorological changes. For example, in birds the annual activity of the reproductive organs occurs early in the year, long before the heat is perceptibly vernal, and ceases long before the heat is autumnal. Meteorological changes have, however, an important influence, but their relation to vital action require to be well analysed; and it must be always remembered, that the influence they exercise is most complex. Thus, for example, the heat of summer facilitates the evolution of miasmata in towns in proportion as it reaches the fœcal excreta or the sewage beneath the surface, and thereby develops epidemics and endemics, as cholera, summer diarrhœa, continued or intermittent fevers. But the decomposing matters may be on the surface, or at varying depths from it, and thereby be affected by the heat in varying degrees. The amount of rain-fall may hinder or facilitate decomposition as well by its influences on the matters to be decomposed, as on the atmospheric temperature, while the amount of vapour in the air will facilitate the solution of the gases evolved. Then again, the heat has a direct physiological or pathological influence on the body generally, and on various viscera in particular, independently of the emanations it causes to be evolved. It is in this way that the problems of seasonal meteorological influences are so singularly complicated. Add to the various changes in the weather which characterise the seasons, all those changes in diet, clothing, habitation, and the like, contingent upon them, and you will easily become aware how large the subject of medical meteorology is, and how numerous the sources of fallacy.

The continually increasing number of meteorological observers throughout the world is a strong proof of the increased attention that is now given to the science. Henceforth medical meteorology must take its place in the cycle of the medical sciences. I know of no data so useful and so complete as those afforded by the Registrar-General of England, in his weekly and quarterly returns, and I have reason to believe that they are sent to every medical practitioner who may desire to possess them, for the purposes of research.

# LECTURE V.

## ON THE DUE ESTIMATE OF TREATMENT, AND ON THE MANAGEMENT OF THE CASE.

### THERAPEUTICAL OBSERVATION.

The due estimate of a plan of treatment, and of the effects of medicinal agents, belongs, I need hardly say, to that part of the subject which treats of causation. You have to investigate the order of a series of events set up by yourself designedly, and therefore with a particular object in view, namely, to induce a certain change, or class of changes, in the system of the patient under treatment. The fallacies, therefore, to which you are liable are identical with those of which I pointed out illustrations in my first lecture, when speaking of etiological research. I shall not enter more into these at present except to refer to a few of the most common sources of error in the therapeutical management of the case.

COMMON SOURCES OF ERROR IN THERAPEUTICAL OBSERVATION.—A very common error in practice is to assume that the remedy has been administered, or the mode of treatment has been carried out, for no other reason than that it has been prescribed. We shall understand this better if we examine a few practical details.

It may so happen that every possible care has been taken at the bed-side, but the drug prescribed is supplied to the sick-room in an impure state. It is well known how largely drugs are adulterated —first by the producers or growers; next, by foreign merchants; next by the importer; next by the drug-grinder, or wholesale druggist; then by the retail dealer or compounder. I do not by any means intend to assert that all growers, foreign merchants, importers, wholesale and retail druggists, and pharmaceutical chemists adulterate their wares, but only this, that some do actually, and all may if they so will. In the United States adulteration of drugs has become (we are told by American writers) an evil of so great magnitude that the legislature has been appealed to, to protect the consumer.

Or the remedy may not have been given from ignorance, neglect, or carelessness of the compounder. He has either substituted another drug for that prescribed—that not being at hand, and the substitution being made with the belief that the substitute is equally good; or it has been omitted altogether; or so negligently compounded, that its medicinal virtues have been destroyed.

Or the remedy has been duly supplied in all its integrity by the compounder, but the nurse ignorantly or carelessly omits to administer it, may be substituting another remedy of her own, or of another person; or, if the nurse be faithful, the patient thinks it no harm to "cheat the doctor" in this way. Great practical tact may be shewn in detecting and estimating these sources of error. Perhaps it is a good general rule to see and examine at each visit the medicines or appliances sent, and to ascertain, either by direct questioning and cross-questioning, or more indirectly, as circumstances permit, whether the remedy has been administered, or the plan of treatment recommended duly carried out.

But supposing the remedy to have been taken, we have still other sources of error to guard against. It may have been rejected by vomiting as soon as swallowed, or it may have been eliminated too rapidly to act upon the system by entering into the current of the circulation. I have known calomel given daily in considerable doses, for a lengthened period, without inducing ptyalism, simply because it was eliminated by the kidneys and intestinal canal as fast as it was taken. And just as the virtues of a medicine may have been injured by improper manipulation when compounded, so they may be diminished or abolished after it has been taken—either by improper diet, or by being taken at an improper time, or by the action of other and counteracting medicinal agents.

FALLACY FROM THE INFLUENCE OF SUGGESTION AND EXPECTATION.—Perhaps one of the most common sources of fallacy is the influence of what has been commonly but erroneously termed the imagination. It is now amongst the established truths of mental physiology, that ideas may become realities without the co-operation of the consciousness; and that whether they originate spontaneously or not, a physiological or pathological change suggested to the mind of an individual may take place really and actually, without the co-operation of any other agent than the suggestion itself. It is in this way that the therapeutic fallacies of mesmerism and homœopathy have arisen. Perhaps nothing is so well calculated to elicit this operation of suggestion, as the method of "proving" a drug adopted by the followers of Hahnemann. The "prover" takes, as he believes, an infinitely minute dose of a supposed medicinal agent, (but, more probably, no portion whatever of it) and then mentally watches, or listens, or feels, as it were, with his attention, for the results that have been suggested to him by theory or otherwise. The anticipated effects will most probably occur; and with a degree of probability proportionate to his mental and corporeal susceptibility.

The expectation of benefit from a medicinal agent often modifies its action favourably. The stimulus to the nervous system of hope and desire, and through the nervous system to all the vital processes, is often very powerful, and always more or less efficient; so that not unfrequently the most incurable diseases seem to derive, and sometimes do derive benefit from remedies taken with hope or expectation of benefit. It is well known to the experienced physician, how often temporary relief is afforded, in long protracted and incurable cases, by a simple change of remedy. To misunderstand the nature of this stimulus, and esteem it as something immaterial, is a common fallacy. So far from this being true, it is as material as any of the *stimuli* received by the system. Nor is it apparently limited to the nervous system; the blood itself, as to its constituents and vital forces, is probably influenced directly and immediately, as well as the organized tissues and the viscera.

FALLACIES FROM UNDERRATING THE IMPORTANCE OR VALUE OF CONCOMITANT MEANS.—I have already remarked that the importance of causes, symptoms, and the like, is often not duly estimated, because they are theoretically considered to be minute or inert. This fallacy is very common in therapeutics. A thorough ablution of the surface may allay fever more effectually than any drug which is given at the same time, yet the benefit be ascribed to the drug. A draught of cold water may act as a most efficient anodyne; fresh air, simple rest of a limb, or a position of the body instinctively sought, will favour sleep more effectually than any sedative. Thus I have known patients obtain rest by assuming the most natural attitude of repose, because the position of the earliest instinct, namely, flexure of the trunk and limbs as in the position of the fœtus in utero. It is the position in which various animals sleep, and is that in which the muscles of the trunk are most completely relaxed, as well as of the limbs. It is a good general rule to be ever remembered by the student, that the simple removal of the causes of a morbid state, or the abstraction of the patient from them, will, in a great proportion of functional diseases, suffice for the relief or cure of the patient. Thus a change of habits of life, of diet, or of regimen, in homœopathic treatment, is equally efficacious with or without globulistic medicaments in the class of dyspeptic cases which are dependent upon unnatural habits of life, diet, or regimen. Delirium of drunkards may be treated very successfully on the expectant method, if the alcoholic stimuli be duly abstracted, and quiet, with proper regimen, and common sense simple means of relief, as cold sponging, darkened room, etc., be adopted.

Fallacy of Mistaking the Natural Tendency to Health for the Result of Medication or Treatment.—We have already seen that many diseases run a definite course and terminate favourably after a series of changes, within a given period. There is no commoner fallacy than to mistake these orderly sequences of vital phenomena occurring according to natural laws for the effects of some favourite method of treatment. In the darker ages of physic, many disgusting, inert, and worse than inert, articles of the materia medica, and many cruel modes of treatment, were believed to be most efficacious from this fallacy. We no longer use scarlet cloth for the certain cure of variola, or rely upon drugs for the cure of the exanthemata in general, because we know the order of development of their symptoms, and their natural termination. Our knowledge protects us from foolish mistakes as to these, but it is equally true that our ignorance leads us into foolish mistakes as to other diseases, and we too frequently rely very weakly upon medication, to the exclusion of a more natural method of treatment.

ERROR OF DOUBTING THE POWER OF DRUGS AND OF TREATMENT.—This has been always a rarer mistake than the opposite; nevertheless it is an error apt to occupy the minds of men who study pathology and pathological anatomy for the purposes of scientific research rather than with a view to therapeutics.

It is an error, too, of those who take a metaphysical view of the phenomena of life. Such inquirers are apt to dwell exclusively on their favourite researches; they are not practical, in the true sense of the term—that is to say, they do not bend their theories to practical uses, nor test their value at the bed-side of the sick. On the contrary, they often prefer to watch the disease with a view to the establishment of a theory, wholly neglecting therapeutics; or they think more of the structural changes that they may find in the body during life or after death, than of the means whereby they can arrest the morbid processes upon which these changes depend. Perhaps the French pathological school presents the most striking examples of this error. Another class of doubters of this kind consists of men of a sceptical turn of mind, who are apt to doubt everything—except perhaps the soundness of their own judgment in thus doubting.

Methods of Estimating the Results of a Remedy or Mode of Treatment.—There are two modes by which the effect of a remedy or mode of treatment may be ascertained. The one is by the comparison of recorded experience with your own;

the second consists in a series of entire new researches.

As to the first method, it is so usual and common that I need not detail it. The same rules which apply to nosological research apply also to this branch of therapeutical inquiry. Just as you should take some well-marked instance of a commonly occurring disease for careful and diligent observation, so you should take some well-established medicinal agent and method of treatment, and observe well and closely its *modus operandi* in every form of morbid action to which it is applicable; noting its action when variously administered as to quantity or dose, or combination with other means or drugs. There are a number of important remedies which merit this close investigation; I would more particularly mention mercury, lead, opium, ipecacuan, colchicum; the iodides, bromides, and haloid salts generally; the great group of terebinthinates; quinine, salicine, and the allied vegetable principles; the purgative gum resins; the astringent vegetable principles, and the like. I need hardly say that published works on materia medica should be carefully studied, while observations on the effects of the remedies are being carefully made. This is the only mode in which thorough tact in the handling of medicinal agents can be acquired. In inquiries of this kind it is always necessary to isolate the patient as much as possible from modifying circumstances, and especially to avoid the administration of other drugs, unless they are administered as part of a well-digested plan.

Original researches into the effects of plans of treatment, or the virtues of drugs, must be carried on according to the laws of the inductive philosophy. It is not possible, even in experimenting on the lower animals, so to exclude all modifying conditions in each experiment, that the conditions shall be the same in all. Here the numerical method of research is particularly applicable; but this I shall refer to again. All I need say now is, that the effect which is seen to follow under all conditions, or in the greater number, is to be considered as the effect of the drug. It is thus we know that jalap purges, that mercury salivates, that chloroform abolishes consciousness.

## MANAGEMENT OF THE CASE.

I do not propose, under this head, to enter into the ethical relations of the practitioner and his patient. This would be foreign to my purpose, which is to shew to you how to manage your patient with skill and tact.

Correction of Incomplete Diagnosis.—It is rarely that you attain to a correct diagnosis in the first instance, and yet it is necessary to prescribe for your patient. In cases of this kind you have to keep two ends in view: the first and principal being the relief of your patient; the second the completion of your diagnosis. Now, as to the first, the practical business is to treat the symptoms so far as you can safely do this. It is above all things necessary to relieve pain and give ease; to arrest the influence of noxious agencies; and to put your patient into the way of relief or cure. Now, to the attainment of these objects, it is only necessary to establish your etiological and therapeutical diagnosis. You may ascertain the causation sufficiently well for practical purposes, and you may see enough of the symptoms to determine what is best to be done, without waiting until you can give the case its nosological position, or until you have determined the pathological changes of structure. In truth, if you do not prescribe until you have done this, you are wholly theoretical; for, as I have shewn, the state of our knowledge as to pathology is necessarily so imperfect that accuracy as to these points is simply impossible.

Circumstances, however, will often prevent you attaining to the knowledge that is attainable. They will often prevent you making the requisite physical exploration or the needful analysis of the urine or other products of excretion and secretion. Information as to the history of the case may be wholly wanting; you may have to wait the recurrence of a paroxysm, and the like. These circumstances vary almost *ad infinitum*, but still you must act, whatever they may be. Now it is when you have to encounter difficulties like these that the greatest tact is displayed, and it is at these times that you will find the value of not having placed your exclusive reliance upon any one method of diagnostic research. Do what you will, you will often have to prescribe tentatively, that is, to feel your way; palliating symptoms, and correcting your diagnosis at one and the same time.

NATURE OF TENTATIVE TREATMENT.—Practical medicine does not permit experiments to be made upon patients—that is to say, such experiments as may be made upon lower animals. These are instituted for the sole purpose of scientific research; experiments on the living man are made for the sole purpose of best affording him relief. They are not therefore truly experiments, but rather modes of treatment instituted to try whether the patient will be benefited or not, or thereby to ascertain the nature of the disease. In this way, quinine or arsenic may be administered in intermittent and periodic affections of a doubtful character; and colchicum in doubtful gouty disorders. There may be an abdominal tumour, the nature of which is obscure; it may be fœcal accumulation, and enemata or purgatives are prescribed tentatively to test the diagnosis. The patient is suffering from incessant nausea, or vomiting; it may be from an irritant retained in the stomach, so an emetic is given, or the stomach-pump is used. But it may be from exhaustion, and then suitable food is administered.

ESTIMATE OF PROBABILITIES.—It will be easily understood, from the remarks just made, that much practical tact may be shewn in the requisite estimate of probabilities. Indeed this, perhaps, is the department of practical medicine in which the most profound sagacity may be shewn. Practical medicine is confessedly a conjectural art; to conjecture wisely is therefore the essence of the art—the whole sum and pith. The numerical method affords us a numerical estimate of the probabilities in a given number of cases, but this is not of much help to the practitioner at the bedside, who has to determine the probabilities in the individual case before him, and which may or may not be more or less similar to the cases estimated numerically. What, in fact, is essential to this sagacity in especial, is essential to form the whole man as a practitioner. He must have the habit of minute and accurate observation, so as to be able quickly to detect all possible circumstances that can throw light upon the case; he must have sound experience, so that he can compare what he now sees with the results of that experience; and he must have knowledge, that he may correct and extend his observations, and correct and simplify his conclusions. Nothing but constant and painstaking exercise of the faculties necessary to these mental processes can give the requisite quickness of perception, comparison, and deduction. But in proportion as these faculties are possessed by the practitioner, as well as in proportion as they are exercised, will he be sagacious in his estimate of probabilities. Some men are wholly unfit, naturally, for the exercise of the art, simply because they want the requisite faculties of mind; some because they want the requisite industry.

Error of Impatient Expectation of Results of Treatment.—When a practitioner has clearly laid down his plan of treatment, he must carry it out steadily, and patiently await the result. Nothing is so detrimental to success in treatment as an indefinite conception of the end to be attained or of the means to be used. The practitioner so situate is constantly vacillating; being swayed by every change of symptom in the patient, or by every expression of opinion he may hear. He is, therefore, constantly changing his remedies or method of treatment. Thereby he renders the symptomatology more confused by superadding the varied phenomena induced by drugs to those of the original affection, and thus at last his diagnosis is utterly bad. In consultation-cases in which treatment has been long continued, or, if not long continued, has been actively pursued, the first step in the examination is a careful separation of the results of this kind of treatment from the results of disease. Thus you may be called into a case in which the starvation-system of certain homœopathists has been rigidly carried out. You may be told it is gastric fever; but in reality the patient is perishing for want of food and drink. In cases of intestinal obstruction, it is not an unfrequent circumstance to find the patient suffering more from the effects of drastic purgatives incautiously taken or wildly administered than from the primary disease. It is a great point in your art to know when to do nothing, and to be able firmly to resist all solicitations to be very actively doing something. A clear conception of the case in all its bearings can only give you this admirable quality. And for this, therefore, you must incessantly labour, never being content until you have exhausted every available source of the knowledge that can help you in your diagnosis.

THE EXERCISE OF A MORAL CONTROL AND INFLUENCE OVER THE PATIENT.—Finally, I would suggest to you the singular importance of so conducting yourself as to be able to control your patient by your moral influence. All your skill and all your pains will be thrown away unless you secure the execution of your plans of treatment. A knowledge of human nature is essential to the acquisition of this influence. Man, but especially a sick man, is a poor creature, easily swayed by his hopes and fears; often looking wildly on every side for help and succour; now with a superstitious faith in a bold empiricism; now with an envious dread of science. You must not appear too wise nor too elevated above your fellow-man—he will be envious of you and fear you; you must not be too familiar—he will contemn you. It is not within my plan to treat of the moral management of the patient; I will therefore only remark, that a quiet self-confidence will generate confidence; a kind, sedulous attention to the case, even to devotedness, will win your patient's affection by indicating the warm and sympathising interest you take in his sufferings; a calm firmness will secure respect. It is by this threefold influence—the confidence, respect, and affection of your patients, that you will be able to carry out to your utmost wishes the plan of treatment you may think right to adopt.

# LECTURE VI.

## THE NUMERICAL METHOD OF RESEARCH IN MEDICINE.

INTRODUCTION.—The summer session is coming to a close, and we shall soon separate—some of you to receive the *honores summi* of the University, others of you to prepare for the attainment of those honours. Amongst the pursuits which will henceforth occupy all of you, there is none of greater importance than the acquisition of medical knowledge by original research. The knowledge acquired even during a lengthened curriculum of study is but small when put in comparison with what you may, indeed ought, to acquire in future years as practitioners, whether as students preparing your theses for graduation, or as junior practitioners seeking and preparing for opportunities to practise your profession, the advancement of medical science by diligent research and study is not less an object of value than of duty. If successful as students in these pursuits, you gain that mark of approbation from the faculty which constitutes a valuable introduction to your future career; if successful as junior practitioners you lay the foundation for confidence with the public in a solid because merited reputation, with your professional brethren ; to all of you, therefore, it must be of interest to know what are the best methods of scientific research in practical medicine, and how those methods can be best put into operation. I have already indicated to you what must be the characteristics of your researches—that they must be profound as well as practical; philosophical in their method and aim as well as laborious and minute. What methods of research secure these characteristics ?

Two methods of research are open to you—First, the numerical; secondly, the inductive, or philosophical. I will briefly explain and illustrate the nature and application of these methods; you will then better understand under what circumstances to use the one or the other; for, as I will soon shew you, they have each a special value, according to the nature of the questions to be solved; you will also better comprehend the mutual aid they may give to each other in the solution of the same question. And first, as to the numerical method of research.

THE NATURE OF THE NUMERICAL METHOD.—It will be well to inquire, in the first instance, into the nature of what is termed the numerical method.

In my first lecture you will remember I pointed out to you the nature of experience in medical art—its sources, and the principles deduced from it, constituting empirical knowledge. Experience, and the empirical knowledge flowing from it, are alike due to observation of multitudinous facts; but the facts from which the principles are deduced are not specifically stated in detail. They are therefore not estimated numerically, nor formally collated in their various bearings on each other. Now, the numerical method is that by which facts and observations are thus formally estimated and collated, or compared, with a view to more definite and accurate conclusions. Experience tells us that a certain event is generally to be expected to occur under certain circumstances; the numerical method tells us how often it is to be expected. Experience tells us that a certain event will be generally followed by another; the numerical method shews how often the sequence takes place. Induction from the facts of experience indicates (and, it cannot be denied, fallaciously, in many instances) the causal relations of things; the numerical method examines and collates more precisely the facts and observations upon which the induction is founded, and gives the results numerically. The numerical method is, in short, none other than that method by which experience and induction are rendered as accurate as possible. When, therefore, we speak of the numerical method in reference to medical science, we only speak, in truth, of a more strict and more systematic method of observation and of induction than the method of common experience.

SPECIAL APPLICATIONS OF THE NUMERICAL METHOD.—It is in its applications to medical science that the term numerical is more particularly applied to this method; when applied to the sciences of legislation and political economy, it is termed statistics, and the principles thereby evolved constitute the so-called science of statistics. A special application to investigations involving the health or life of man, in his social relations, is termed vital statistics. Public hygiene, or the science of the social causes and prevention of disease, is the branch of medical science to which vital statistics has been specially applied.

The numerical method is also used in the physical sciences; but the phenomena with which these sciences are conversant are so very different from those of life and organisation, that, except for illustration, I need hardly refer to its uses in this direction. In proportion as the phenomena are simple and expressible in numbers, in the same proportion the method is of easy, certain, and simple application; and conversely. Physical phenomena are so simple and so expressible; vital phenomena the converse. Hence, as applied to medicine, the numerical method is difficult, fallacious, and complex. These qualities belong to it in very different degrees, however, according to its special application. If it is applied to events, simply, as in symptomatology, it is less fallacious than when applied to determine the causal relations of the events, as in etiology or therapeutics. But it is fallacious even when applied to what may be termed the simplest events in medicine, inasmuch as that accuracy of observation which is requisite with reference to each particular event of the aggregate numerical expression is often wholly wanting, and always only partially attainable.

MERITS AND DEMERITS OF THE NUMERICAL METHOD, AS APPLIED TO MEDICAL SCIENCE.—These inevitable difficulties have been quoted by some to the entire disparagement of the method itself, while others, looking at the brilliant results achieved by it in the domain of the physical sciences, have wholly forgotten them, and praised it overmuch. Let us next, therefore, inquire how far, when applied to medical art, the numerical method embodies, in general numerical expressions, the results of repeated observation and long-continued experience. I have lately had occasion to call your attention clinically to two very common diseases, hæmoptysis and tubercular phthisis. Now, the intimate connection of these two, in the way of cause and effect, has been a matter of medical observation since the Hippocratic age. Louis first, and, more recently, Walshe and others, have expressed this relation numerically. Walshe found that about four in every five tuberculized persons had hæmoptysis in the first stage of the disease, or, more accurately, 80.92 per cent. This general fact was drawn from inquiries (not observations) made as to the occurrence of hæmoptysis in 165 individuals—the accuracy of the answers to the inquiries depending upon various circumstances involving these 165 different persons. It is clear, therefore, that the very basis of the numerical method, namely, the individual facts, is widely different in medical and in physical research. In the one there may be a uniformly established accuracy or inaccuracy; in the other the accuracy or inaccuracy may vary within the widest conceivable limits. From the differences in the nature of the facts, necessarily arise differences in the modes of acquiring them, and therefore equally great differences as to the result. But when clinical facts are used which have been collected by several observers, as they necessarily must be in research, the difference is even more apparent. Many astronomers may observe the same star, many chemists may analyse the same matter, and their observations may be combined numerically, so as to attain a near approximation to the truth; for the general conditions under which the observations are made are identical, thus securing one of the most important requisites to accuracy. All this is wanting in clinical inquiry. Further, the observations are made upon individuals, each of necessity differing widely from the other; or if upon the same individual, he varies much in his condition, at varying intervals of time; so that, however exactly the observer may observe, and however diligently he may seek to multiply facts, which, being alike, can be compared numerically, he can never attain to the necessary exactitude and similarity.

Even as to things capable of exact numerical expression, the difference is the same. The astronomer having duly measured the movements of a star, or the chemist having carefully and repeatedly analysed a portion of matter, has fixed for ever the mathematical elements of the star's position and course, or the numerical proportion of the constituents of the matter. Quite otherwise with the clinical observer; he cannot accurately express in numbers the simplest vital events. He may count the pulse; but, when counted, its rapidity is but one measure of the state of the circulation; he has still to express numerically the force and rhythm varying from hour to hour independently of any structural change. He may express in figures the rapidity of respiration, the temperature of the body, the amount of urinary and alvine excreta, so far as he is permitted or able to observe them numerically; but he may not be permitted, or may not be able from various circumstances; and when he has observed all he can, much remains that he cannot take note of.

Of how great importance to sound clinical research it may be to determine quantitatively the gaseous products of excretion through the skin, lungs, and intestinal canal, is obvious though hardly suspected; yet how difficult to make the necessary observations.

FALLACIES OF OTHER METHODS USED IN MEDICAL RESEARCH AFFECT EQUALLY THE NUMERICAL.— Events that are comparable by the numerical method are most usually expressed in general terms, as "hæmoptysis," the event of a spitting of blood; "ascites," the accumulation of fluid in the abdomen, and the like. I have already shewn to you what fallacies in reasoning lurk in the indefinite use of these general terms, and I need hardly remind you that they are equally fallacious when used for the inductions of the numerical method; while they express that which we have observed, they also include much that we have not observed. How much of fallacy may lurk in the numerical expressions drawn from data of this kind, simply from the want of observations, is not readily conceived at first; for we are too ignorant to comprehend the full extent. Experience teaches us something, however, in this respect. Let us suppose, for instance, that ascites had been investigated numerically antecedently to the recent advances in renal and cardiac pathology. The accumulation of serous fluid in the peritoneal sac, constituting the condition termed ascites, may arise from various diseases of the heart, the liver, the kidneys, or the peritoneum itself; this being remembered, the supposition shews at once what a heterogenous mass of facts would have been collated, many of them having no true grounds of comparison. All our collective terms being so fallacious, the collective facts which they express are necessarily fallacious too, both as to the deductions that may be drawn from them, and the simplest information they may convey.

But having attained by this method to an accurate numerical expression of a general fact, that expression admits of only very limited application to individual cases, inasmuch as special conditions may be at work in these, not taken into account in a numerical estimate. If it has been shewn numerically, that four-fifths of persons attacked with pneumonia have recovered after, or even in consequence of the administration of a certain drug, as tartar-emetic, we still want to know whether the individual case under treatment should be classed with the four-fifths that were benefited by the remedy, or with the one-fifth that were not. This inquiry at once involves a complex numerical estimate of special conditions in each case—a thing difficult under the best circumstances, but often impossible, for the reasons just stated.

ILLUSTRATIONS OF THE USES OF THE NUMERICAL METHOD.—There are, however, numerous events of a character sufficiently simple, that may be tabulated numerically with useful results to medical art. I allude to such events as death, the result of a surgical operation, delivery of a child in relation to the age of the patient, the sex of the child, and many similar. You will find some very instructive illustrations of these uses in an excellent paper by Professor Simpson, entitled "Value and Necessity of the Numerical Method as applied to Surgery," published first in the Edinburgh Monthly Journal of Medical Science for November 1847, and more lately in vol. ii. of his "Obstetric Memoirs and Contributions." I would refer in especial to the facts stated in support of his fifth proposition, as to the value of the method for correcting the fallacies of limited and unrecorded experience; and also under his sixth, as to its uses in causation, by determining numerically the relations of various conditions, such as the age, sex, *etc.*, of the patient. There can be no question as to the great and valuable uses to be made of the numerical method in correcting and enlarging our experience of clinical events and conditions. It must especially be borne in mind, however, that a simple numerical statement of one event, or of the relation of one event to another, may be free from fallacies, when deductions from that statement may be wholly erroneous. I have already quoted a numerical statement as to the relation of tubercle to hæmoptysis. Now, a hæmoptysis may be either the result or the antecedent of tuberculization; in other words, either the cause or the effect—a question of great importance in clinical medicine, but not to be determined without the aid of pathological anatomy and histology, as well as of clinical observation. What is the value of this numerical fact, then, you will ask? Simply this: if you have a patient with the signs or symptoms of pulmonary tuberculosis, even although doubtfully and obscurely manifested, the occurrence of hæmoptysis is a sign of the highest value, *quoad* the treatment, for it determines the necessity of the most sedulous *prophylaxis.* And inasmuch as tubercular phthisis is best treated in the earliest stage, and since in proportion as it is incipient, the signs and symptoms are obscure, it follows that hæmoptysis occurring under such circumstances, has a greater value, *quoad* both diagnosis and treatment, than under any other. The proportion may not be exactly four-fifths as alleged; the disease may not be exactly tubercular phthisis; still, for practical purposes, the general fact is valuable. It shews this, at least, that hæmoptysis is a common premonitory symptom of a class of chronic pulmonary diseases that are commonly fatal when fully developed.

STANDARDS OF COMPARISON OF THE NUMERICAL METHOD.—The application of the numerical method to determine causation, and its uses as an instrument of inductive analysis, constitute more complex processes.

In the measurement of physical changes and conditions, a standard of comparison is always required. Hence the heat, weight, and density of bodies are measured by instruments graduated to such a standard, as the freezing and boiling point of water in the thermometer, the height of a column of mercury in the barometer, etc. Standards are equally required to carry on the numerical analytic investigations into the phenomena of life and society. Perhaps the most important of these is the Standard of Health, or the National Life-Table—the mode of construction and uses of which you should thoroughly understand. A life-table simply embodies the experience of the nation as to the duration of the lives of the people. Its elements are very simple; they are—1, The numbers living, and their ages; 2, The numbers dying, and their ages; and, 3, The numbers born—each head referring to a given time, as a year. The national registrations of births and deaths in England and Wales, and the census of 1841 and 1851, have placed the data for an accurate English life-table in the hands of statisticians. A life-table shews, out of an assumed number (say 100,000) born alive, the number living at every age for 100 or 105 years. The assumed number (whatever it may be), is technically the base or *radix* of the table, and the yearly deaths are called the "decrements of life." The expectation of life, or mean age, differs from the "probable duration of life;" the latter is the time in which the number living is reduced just to one-half; the former is obtained by dividing the sum of the years lived by the total number, and so ascertaining the mean.

For commercial or financial purposes, the life-table is invaluable. Although the duration of the life of each individual is proverbially uncertain, that of 100,000 may be estimated to a fraction. But life insurers have this further security against loss, that while the Life Table they use is constructed on data drawn from every rank and condition of men, and under every possible condition as regards state of health, diet, occupation, and the like, they only accept select lives, that is, persons in actual health, likely to live long, temperate in their habits, pursuing healthy occupations, resident in a healthy climate, etc.

To conduct numerical inquiries in hygiene, you must use a life-table as a means of comparison. Suppose that it were desired to ascertain the influence of factory labour upon children, or of a residence in a school or a city, the first point to be determined would be a standard of measurement; this is afforded by the average probability of infantile life, as shewn by the life-table. Then, the numbers of children living and dying in each year under the circumstances to be investigated should be ascertained by observation, and properly tabulated, when the results could be compared with the life-table. The degree in which the probability of life is increased or diminished, measures the general influence or duration of life of the circumstances in which the children are placed, whatever those circumstances may be.

APPLICATION OF THE NUMERICAL METHOD TO SIMPLE EXPERIENCE.—But let us suppose that you wish to determine some question in medical experience, as, *e. g.*, the fatality of a particular mode of amputation of the thigh. You would first establish a standard of mortality, by collecting all the accessible histories of amputation of the thigh, in so far as they stated the events necessary to be known, namely, the mode in which the thigh was amputated, and the event, whether recovery or death. The proportion of deaths to recoveries from every mode of amputation would constitute your standard of comparison. Having got this, you then tabulate your cases numerically, according to the respective modes in which the amputation was performed, and ascertain the proportions of deaths to recoveries by each mode. If, when compared with the standard, the proportion is found to be less, the experience is favourable; if more than the standard, it is unfavourable. This comparison, however, tells you nothing more than this simple fact of experience;

the causation or reason of the differences, remains to be investigated by other applications of the method.

The construction of standards of comparison lies at the root of all numerical research; consequently, the first application of the method is directed to the construction of such standards. The pathological anatomist, for example, may weigh the heart in every autopsy, but he can never state how much it is above or below the average, until a sufficient number of healthy hearts have been weighed, and the average weight determined. Unfortunately these standards require to be numerous in medical science, while it is often very difficult, almost impossible, indeed, to construct them.

DETERMINATION OF THE ORDER OF EVENTS BY THE NUMERICAL METHOD.—One of the great objects of numerical investigation is to determine the order of events, or, in other words, the relations of cause and effect. This is, indeed, emphatically, *the* knowledge aimed at. The process is a complex one; it is, virtually, a succession of theories and of provings of theories by the numerical method. It differs only, therefore, from the method I have described in a previous lecture as to the additional instrument used—

namely, numerical synthesis and analysis. Perhaps one or two instances of the practical application of the method to this object will instruct you more than long descriptions; these, therefore, I will give you.

Dr. Simpson, in the paper to which I have referred you, proposes to determine the influence of age on the result of the operation of lithotomy, and for this purpose he tabulates instances of lithotomy under two heads—namely, the result and the age, taking four periods of the latter—the first ten years of life; the age from ten to twenty; from twenty to forty; from forty to eighty. This shews that the rate of mortality from the operation increases as the age of the patient advances, so that while three per cent die of patients aged under ten years, thirty-three per cent die of patients aged between forty and eighty. It follows, therefore, that circumstances connected with the age of the patient, influence the results of the operation; but the special circumstances are not revealed by the process.

Again, Dr. Simpson proposes to ascertain how far the size of the stone influences the result of the operation of lithotomy. He therefore tabulates the two events. The size of the stone being tabulated under the heads—under 2 oz., from 2 oz. to 4 oz., and from

4 oz. to 7 oz. in weight. The result is that, while only ten per cent die with the lowest-sized calculus, fifty-five per cent die with the highest sized. Why this is so, is not, however, revealed by the process.

There are, therefore, various other conditions to collate, so that the etiology may be completed. It may be supposed, *a priori*, that the largest-sized calculi occur in the most aged patients, and consequently that the age may affect the mortality, and not the size of the stone specially; or, as is more probable, the two may co-operate. To determine this point, a fresh tabulation is required, and the relations of age to the size of the stone should be ascertained numerically—the percentage as to deaths at the several ages, from all sized stones being taken as the standard of comparison. But this is not all, for other conditions may exist. The slowness or rapidity with which the calculus formed might be another element in determining the event; or its chemical composition; or the diathesis of the patient; or the complications in each case, as renal or hepatic disease, gout, chronic inflammation of the bladder, etc. For the determination of these and similar questions by the numerical method, minute and accurate observations are necessary, otherwise the information as to the conditions determining the event in lithotomy cannot be thoroughly and satisfactorily investigated.

SOLUTION OF COMPLEX QUESTIONS IN ETIOLOGY BY THE NUMERICAL METHOD.—The able "Contributions to Vital Statistics" of Mr. Neison contain illustrations of every kind of numerical investigation, and of the varied applications of the method. From amongst these I select an interesting inquiry into the rate of mortality of medical officers of the Royal army, as shewing the uses of the method in the solution of complex etiological questions. Mr. Neison collected his facts from the records of the Society of Widows of Officers; and I ought to say that his inquiry was instituted with reference to the financial management of this society. Now, as the matter concerned the viability of the married officers only, inasmuch as they alone could leave widows, his first step was to separate them from the unmarried. At the same time, with a view to forming a standard of comparison, he determined the numbers entering the service unmarried liable to death at each age, and the numbers dying—with other particulars necessary to insure accuracy, but not necessary to my illustration.

Comparing the results of this tabulation with a general standard of comparison—"The National Life-Table"—he found that the mortality amongst unmarried army surgeons between the ages of twenty and fifty-four not only much exceeded the mortality of the male population at similar ages of England and Wales, by 124½ per cent, but was actually about equal to that of the Bengal military service at corresponding ages. More remarkable still, the mortality was found to be largely in excess at the youngest ages, being more than four times above the average of England and Wales at the same ages. Mr. Neison next tabulated in like manner the married officers, and he found the mortality of this class to be considerably less. At ages twenty-five to twenty-nine the mortality of the unmarried was at the rate of 2.928 per cent; of the married, was at the rate of 1.190 per cent—the mortality of the same ages of the male population of England and Wales being 0.981 per cent. Thus arises the question—Are the married subject to less mortality than the single? If so; why?

This inquiry is made by tabulating those only who *remain* single all their lives, and, therefore, excluding those who *entering* single, married sooner or later. The effect of this exclusion is to exhibit single life under a still more unfavourable aspect, by shewing a still higher rate of mortality amongst the unmarried; so that Mr. Neison comes finally to the conclusion, after a succession of corrective tabulations, that the duration of life of the unmarried ought not to be taken into the estimate in calculations intended to measure the duration of life amongst the married, the mortality of the two classes being widely different in favour of the married. What, then, are the causes of this difference? Theoretically it was argued that the younger medical officers are sent to unhealthy stations. The theory was tested numerically—first as to the actual mortality of such stations; and secondly, as to the mortality of those actually sent; and it was found that if the whole of them had been constantly resident in India, or in other equally trying climates, such residence would not account for the extraordinary mortality of the younger medical officers of the army. And there the question is, for the present, left. Probably the next direction the enquiry will take, will be the domestic habits and modes of life of the two classes.

## SOLUTION OF COMPLEX QUESTIONS IN PUBLIC HYGIENE BY THE NUMERICAL METHOD—SOURCES OF

FALLACY.—Vital statistics applied to public hygiene constitute, in fact, a numerical method for investigating the etiology of diseases affecting large masses of the population analogous in its details to the preceding. These statistics are liable to serious fallacies, and as public hygiene is now a recognised branch of the profession, I think I shall do well in pointing out to you how they originate. It must be always remembered that, in proportion as the circumstances or events to be compared increase in number, the sources of fallacies increase in perhaps more than a geometrical proportion. Now the conditions which affect the health are very various, and very varying. Age is one of these: if, therefore, the ages of the living be not tabulated under something like quinquennial periods, the results will be utterly fallacious. Again, sex is another important condition; so that both age and sex must be brought into tabulation. Employments and condition of dwellings, *i. e.*, whether rural or urban, agricultural or manufacturing, are also equally important elements; and last mentioned, though not least important, the state of education of the people influences their mortality. Add to these density of population, ventilation of dwellings, state of sewerage and drainage, nature of the soil, altitude of the surface, etc., and you will readily understand how many fallacies may arise simply by the omission of some necessary element.

FALLACIOUS USE OF NUMERICAL CONCLUSIONS.— One more point I would mention, namely this:—A numerical statement may be true, as a mere fact of experience, but fallacious as premises for comparison and deduction. As an illustration of this source of fallacy of a simple character, I will again revert to the numerical statements as to the relations of hæmoptysis and tubercle, and which we have already seen to be a useful addition to our experience. I need only here repeat that, according to Dr. Walshe's researches, four-fifths of tuberculized persons have hæmoptysis in the first stage of the disease, or more accurately 80.92 per cent. This at first glance is a definite and pure fact. We think we clearly comprehend what we understand by the phrases, "first stage of phthisis," and by the word "hæmoptysis," and we conclude that in the 165 cases inquired about at the Hospital for consumption which afforded Dr. Walshe these data, these conditions, as we understand them, occurred. Still the remarks I have already made as to the fallacies which lurk in the uses of terms, will have prepared you for a rigid scrutiny of the facts thus generalised numerically, and you will be cautious how you deduce inferences from the generalisation. But the accuracy of the terms being granted, what, etiologically, does the fact teach? Let us inquire. It has been inferred that inasmuch as hæmoptysis is so frequent an antecedent of tubercular deposit, that it is equally a frequent cause, sign, or indication of tubercular deposit; or, if not of that, of at least the predisposition. Is this inference correctly deducible from the numerical fact? I think not; for this reason, that all those persons are wholly excluded from the data so generalised, who having had hæmoptysis have not had tubercular disease. Hæmoptysis will undoubtedly occur in other constitutions than the tubercular, and from other morbid conditions than tubercular deposit in the lungs; but Dr. Walshe's general fact refers only to those who by the very circumstance of their going to the Hospital for consumption, shew that they have probably tubercular deposit already; whether as a cause or effect matters not. If we for the sake of argument allow, therefore, that four-fifths of tuberculized persons are hæmoptoic, we cannot at all concede that four-fifths of hæmoptoic persons are tuberculized. The data for the numerical fact do not include all hæmoptoic persons, whether tuberculized or not, but only those who actually are both. The observations themselves are in fact wholly insufficient to determine the etiological question. It would be necessary for this purpose to include in the inquiry all hæmoptoic people at least—tabulating them under age and sex, and for successive quinquennial periods with the event, that is, death from tubercle or such other alternative events as might be fixed upon, if we would satisfactorily determine the etiological relations of tubercle and hæmoptysis. But this would again lead us further to inquire and determine, what is meant by tuberculisation and tubercle; and here we come at once upon debateable ground, namely, the meaning of collective terms.

HINTS ON THE APPLICATION OF THE NUMERICAL METHOD TO MEDICAL RESEARCHES.—I will conclude with a few hints as to the precautions necessary to be taken when you wish to apply the numerical method to the investigation of questions of life and organization.

1. It is most essential that the observations, facts, or events, be as nearly alike as is practicable. There

may be a numerical statement as to two events, *e.g.*, life or death, applicable to the entire number; or the observations may be grouped under subdivisions, *e.g.*, for the purpose of determining numerically whether male or female live or die; these again may be arranged under ages; again under employments, diathesis, race, and the like.

2. The number of observations should be considerable. In proportion as they are numerous, and at the same time accurate and comparable, in the same degree the results are trustworthy. As a general rule, it may be stated that the tendency to fluctuation decreases as the intensity of the law approaches unity. For example, there is much less fluctuation observed in the law of mortality from cholera than of that from typhus; because in the former it is nearly 40 per cent—in the latter about 10 per cent.

3. The calculus of probabilities supplies the means of correcting errors from a small number of observations. This teaches us that where an event has been observed to happen a certain number of times in a given number of cases, the probability of its happening again is not represented by the actual number observed, but lies between limits somewhat

greater and somewhat less than that number; these limits varying more widely as the number of observations are few.

4. The observations must be scrupulously accurate, at least as to the events or circumstances that you tabulate. In selecting published observations, care must be had as to the capacity and trustworthiness of the reporter. As a general rule, without taking into consideration the merits of individuals or the weight of names, reports from hospitals, or reports made under circumstances such that more than one or two have witnessed the cases detailed, are to be preferred to less authentic facts. But cases of very varying degrees of accuracy or fulness may be used, provided there be accuracy as to the special points tabulated. If, for example, you are investigating questions as to strangulated inguinal hernia, the age, the sex, and whether on left or right side, may be correctly stated in a case when the duration, the progress, and the termination may be untruly or incorrectly given. Such a case is available, therefore, for tabulation, as to the three points of accuracy, although worthless as to the other statements.

5. The heads of tabulation may be as numerous as is convenient, but the analysis should be limited

to heads that are well defined and susceptible of disclosing a law; for in proportion as the events or phenomena are complex and the heads numerous, the investigation is difficult and its results uncertain. Beyond a certain point algebraic formulæ become necessary and the necessary calculations are not only laborious, but require a larger acquaintance with mathematics than students are expected to possess.

6. It must always be borne in mind that although the elements are correct, the mathematical certainty of the method applies in absolute strictness to the entire mass of the facts only, and not to the individual instances. In other words, you cannot reason more mathematically or absolutely from the general to the particular than you can from the particular to the general.

7. Numerical tabulation and analysis is an art only to be acquired by practice and by imitation of the best models. When applied, the extent of its application will depend, in part at least, upon the extent of the knowledge of the things investigated possessed by the inquirer.

# LECTURE VII.

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## THE ANALOGICAL, PHILOSOPHICAL, OR PURELY INDUCTIVE METHOD OF RESEARCH.

COMPARISON OF THE NUMERICAL AND ANALOGICAL METHODS.—In the numerical method we have, I hardly need say, a truly philosophical and inductive although limited method of research. It deals with facts in the first instance, and proceeds from step to step by theory and observation to more and more general principles. Its peculiarity is this, that inasmuch as it reduces everything to numerical ratios and expressions, it necessarily deals only with facts and observations capable of such reduction. But these are but a few of the facts of medicine. The method which I designate more especially the analogical, philosophical, or purely inductive method of research, is not thus restricted. It extends its inquiry to all facts. It uses the numerical method as an instrument of acquiring general facts, but as a subordinate instrument only. The intellect is its great means of research. It works both by theory and observation; but theory (the result of thought) is of as great importance as observation, because it guides it.

I have already said sufficiently as to the processes of thought by which we arrive at knowledge in this way. "To theory," I remarked, "we owe all *true* progress in knowledge." On the present occasion I propose to shew to you how to theorise with a view to scientific research. I must premise, however, that just as for the attainment of experience, and just as in the application of the numerical method, there must also be, for the right use of this method, acuteness and accuracy of observation, cautiousness of inference, discrimination in classifying facts, sagacity to generalise them, and finally, skill to apply the generalisations reached either to practical uses or to fresh and wider researches.

FIRST STEP; DISCOVERY OF A PRINCIPLE FOR THE THEORETICAL COLLOCATION AND COMPARISON OF FACTS.—The first step in this method (as in the numerical) is the collocation and comparison of facts or observations according to some common principle, or with reference to some common principle—either numerically or not. Astronomy and the physical sciences have fundamental common principles by which the construction of theories and the observation and collocation of facts or observations can be regulated. Thus when Adams and Le Verrier theoretically determined that a large planet was revolving on the furthest bounds of our system, although hitherto imperceptible to the eye of man, they had for their guide the great principle of gravity and its laws. Now it is often asserted and lamented that medicine has no such great principle—no great primary FACT to which all theories and researches shall point, and by which they all shall be guided. Hence it arises, it is argued, that medicine is uncertain, and cannot be investigated with the same prospects of success, or even by the same methods, as the physical sciences. I demur to these views altogether. I not only am satisfied that medicine has, like other sciences, its great primary fact or principle, but I can speak positively, because from experience, as to its value and uses.

THE FUNDAMENTAL PRINCIPLE OF MEDICINE STATED.—Practical medicine has the treatment of disease for its object. Now disease is simply a deviation from the natural order of events as to the structure and functions of the body. The knowledge of that order is physiology; and the knowledge of that order disordered is pathological physiology or pathology; still however physiology. For a long time, it was believed that man was something apart from the rest of creation. He was believed to be its "Lord," and not subject to those laws in virtue of which his fellow-creatures exist. Just as it was formerly an assumed fact that the earth which he inhabited was the ruling sphere of the heavens—the controlling centre of the sun, and moon, and stars—so was man esteemed to be the centre and ruler of organized life. But as advancing cosmical knowledge has dispelled the one delusion, so advancing physiological science has dispelled, in part at least, the other. Man, like the earth he inhabits, has his harmonious yet subordinate position in creation. He is certainly a leading link in the infinite scheme of life, yet he is but a link. This is the great truth of human physiology. Expressed more technically, we may say that the primary or fundamental principle of life is the unity of structure and function of organisms both in time and space. This, then, is the point to which all your theories should tend, the principle by which they should all be regulated. This should be ever present to your thoughts; this should ever guide your observations. Thus used, it is the bond that will bind science, and observation, and tact together, and confer upon you the highest qualities of the practitioner, namely, the power to take profound philosophical views, and the ability to apply those views to the practice of your art. The principle thus announced will doubtless be severely questioned, and its truth controverted, but it will finally be almost universally accepted.

THE PRINCIPLE OF LIFE AND ORGANIZATION IS OF UNLIMITED APPLICATION.—And do not think that in presenting this great primary fact to your notice, I wish to place any limits whatever to its application. Just as the great law of matter is applicable to the countless suns and systems that for countless ages have swept and still sweep through infinite space, whether they be already discovered or are still to become visible—so this great law of life is applicable to all life, whether animal or vegetable; to all organisms; to all functions, whether comprehended or yet to be discovered; to life in all epochs; to all living things of the past, as well as to all of the present. The Rev. Baden Powell admirably observes—"Throughout all formations, the grand truth to which every accession of geological discovery bears witness, is the principle of unity of plan continually exemplified in all the varieties of organic structures disclosed. Even the most seemingly monstrous and incongruous forms of animated existence in past times are all, without exception, constituted according to regular modifications of a common plan, and with parts, organs, and functions related by the closest analogies to each other, so that no sooner is a new form discovered, than it is instantly assimilated with some known type, and found to hold an assignable place in the system."* And again—"Of organised life we find some of the conditions equally unchanged [as the physical]; the animals and plants of these remote epochs were like those now existing; subject to the same general physiological laws of respiration and circulation, digestion and nutrition, locomotion and instincts; their eyes and ears adapted to the same optical and acoustical conditions; their reproduction generally regulated by the same laws."†

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* Essay on the Unity of Worlds. By the Rev. Baden Powell, M.A., etc. etc., p. 337.

† Ibid, p. 359.

Although this great principle ought to be alike the basis and climax of your theories, it need not by any means be the starting-point of all. There are many minor or subordinate principles, the bases of less and less comprehensive generalizations, which you will use in your theories. You will often find it wholly unnecessary to pass beyond a principle of very limited application, and very distantly related to any higher. But these matters will be best illustrated by details of the principles and processes of the methods.

RELATIONS OF THEORY TO THE ANALOGICAL METHOD.—In the first place, let me explain to you what a theory is in the working of this method. Having your observations before you in their individual relations or in a generalised form (either numerical or not, according to circumstances), you proceed to compare them and tabulate them as it were, according to their resemblances or differences. The proper result of this process of tabulation and comparison is the discovery of an analogy, and the phenomena so treated are analogous. The comparison may lead to a generalisation sufficiently definite to constitute in itself a unity of phenomena. Thus you compare all the facts known as to a certain class of remedies, *e.g.*, the inhaled anæsthetic gases, and you find that they have in common two things,—1st, The property of modifying the nervous system when brought into contact with it, so as to alter or abolish sensorial sensibility; 2dly, That they are all compounded of the same two elements, carbon and hydrogen. They are therefore analogous in their composition, and analogous in their effects. The result is, however, simply a general expression of facts, corresponding to the results of a primary numerical tabulation, or to a simple fact of experience. *Why* these compounds of hydrogen and carbon should thus act under given circumstances is not at all shewn. To determine this question of causation, analogous phenomena manifested under analogous circumstances in analogous structures would have to be compared, and the order of their occurrence investigated; in other words, experimental researches would have to be instituted. But how would you determine what were analogous? By the aid of the great fundamental principle of life—the principle of unity of structure and function. This would enable you to compare general facts, and see which were analogous and which were only similar. Then a general exposition of them in their relations to each other would constitute the theory. This general exposition would theoretically assume individual facts and details to be either probable or true, not yet observed or investigated experimentally.

IMPORTANCE OF KNOWLEDGE TO THE EFFECTIVE USE OF THE ANALOGICAL METHOD.—It hardly needs any comment to shew how necessary the most thorough physiological and pathological knowledge is to this method of research, for it is clear, from a moment's consideration, that such analogies can only be perceived through such knowledge. When Newton caught the analogy between the force which carries an apple to the earth, and the force which regulates the planetary movements, his mind was already familiar with the phenomena of the planetary movements, and had often classed and reclassed them for the purposes of comparison. The perception of such analogies is usually described as a happy accident, but the word accident has no place in the language of the philosopher. It was really and truly in this instance, as in all other similar instances, the culmination of a series of inductive processes, carried on perhaps instinctively and almost automatically, but not the less inductive, and not the less occupied with observed phenomena and their analogies. Men differ much naturally in their capability to perceive the true relations of things, that is, to detect the phenomena which can be properly compared, and which present true analogies. To seek for analogies is an instinct of the human understanding, and therefore a faculty of general use and application; to discover those that are true and fitting is the characteristic of genius. Hence many seek for and use analogies, false though they be; few use analogies rightly. Göethe had the power to find and use them in a high degree, and, in consequence, was enabled to perceive and demonstrate the principle of unity which regulates the form and structure of the various and apparently altogether dissimilar parts of a plant. So also Geoffroy St. Hilaire, in possession of a similar faculty, detected and demonstrated the principle of unity of structure in animals by means of numerous analogies—a principle I would remark already hinted at by Newton. In like manner Von Bär pointed out the unity of development; so also Göethe and Oken perceived and illustrated the analogy in development between the bones of the skull and the bones of the spinal column. Professor

Owen, taking up and working out this idea, extended it far beyond its original applications, and shewed that the analogy was between the bones of the limbs and of the skull, and the parts of a vertebra as well as between the two latter; thus demonstrating the true nature of limbs.

DIFFERENCE BETWEEN THE METHOD OF ANALOGY AND OF BLINDLY WORKING OBSERVATION.—You will easily comprehend the difference between philosophical theories and the theories of blindly working observation and experience; the former are corrected and limited by fixed fundamental principles, the latter are not. In the one it is just as if a man had to find out *a* something, not knowing how to look, where to look, or what to look for; in the other, as if he were told what the something was, and where and how it might be found. This may be noted in all the great analogies just mentioned; in each the principle to be demonstrated, and the facts required for the demonstration, are clearly indicated. All that was needed, therefore, to be done was to make a diligent observation and collation of the facts necessary thereto. So also as to the planet perceived analogically by Adams and Le Verrier; the idea directed astronomers when and where to look for it, and see it actually; they watched carefully, and saw it.

HOW TRUE ANALOGIES MAY BE DISCOVERED.—The next point to consider is the mode in which true analogies may be discovered, so as to guide observation and experiment aright. It consists in none other than that same method we have seen used in numerical tabulation—the simple principle being this, that phenomena agreeing upon one point be collated as to that point in all their relations. For example, if certain of the phenomena of the growth of a flowering plant, from the first vivification of the germ-cell to the perfect evolution of the sexual organs, be compared with the corresponding phenomena of an animal (as man), a series of distinct analogies are discoverable. As the primary phenomena, we have in both the union of a sperm-cell and a germ-cell, and the primordial cell from that union formed; as the last, we have in each a form developed from a primordial cell to the perfection of beauty, concurrently with perfection of the reproductive organs. These analogies are true in fact; they, therefore, are in accordance with the great fundamental law of unity.

Being *so* true in fact, and *so* in accordance, the multitudinous intermediate analogies may be equally conceived theoretically, and demonstrated by observation and experiment. All that is requisite is a sufficient knowledge of the intermediate phenomena in one or in the other class of organisms. I say the one or the other, because if known in one, they may be inferred as to the other.

DISCOVERY BY TRUE ANALOGIES ALWAYS PROGRESSIVE.—Just as in the numerical method the result of one tabulation leads on to another tabulation, and its result to another, so one analogy leads on to another investigation and arrangement of phenomena and another analogy; this to another, and so on *ad infinitum*, or so long as the inquirer can carry on his researches and attain to new facts. The only limit, indeed, to his discoveries is to be found in his limited powers of investigation; but the intellect practised in this method will penetrate in *idea* far beyond the horizon of the demonstrable, and see more or less clearly in the far distance analogies grander and yet grander still. The principle of unity of life and organization is all comprehensive; MIND, therefore, comes within the range of its operations as well as matter. This is a grand principle; for it is pregnant with researches and results of the highest importance to man in his social, moral, and intellectual relations.

## PRACTICAL EXAMPLES OF THE CONDUCT OF AN ANALOGICAL INVESTIGATION.

EXAMPLE 1.—INVESTIGATION OF THE PATHOLOGY OF "BRONZED SKIN."—I will give you some illustrations of the application of this method to pathological researches, and will take in the first instance an interesting question for solution—the pathology of "Bronzed Skin"—a form of discoloration of the skin which has of late attracted considerable attention. The initial step in the inquiry is the collection and collocation of individual instances of the disease; the next is to tabulate these instances, with a view to discover a common point of agreement. Now this has been already done; first by Dr. Addison, who first directed attention to the disease, and afterwards by Mr. Hutchinson of the Free Hospital in London. Dr. Addison found that the structural change common to all was a change in the structure of the supra-renal capsules; Mr. Hutchinson confirms this conclusion. Other common points of agreement have been mentioned; in particular a degradation of the blood inducing an anæmic state. Hence it has been theoretically inferred that there is a relation between the functions of the supra-renal capsules and the process of sanguification; hence, also, it has been theoretically concluded that discoloration of the skin is pathognomonic of disease of these structures. These are our conclusions from what may be termed the first tabulation or comparison of facts.

The next step is to determine the relation—1, Between the discoloration and the structural change in the capsules; 2, Between the anæmia and the structural change; 3, Between the discoloration and the anæmia. If we inquire as to the first, we seek to know what are the analogies between this morbid discoloration and other instances of coloration in similar tissues and organs. To determine these analogies we want phenomena and observations that can be compared, and, in particular, it is first necessary to know in what the discoloration itself consists, so that suitable phenomena may be compared and true analogies deduced.

The next step, therefore, is to tabulate and generalise as to this point; and we find, after due comparison, that we can limit the inquiry to colouring matter deposited from the blood; for by the way of exclusion we learn, temporarily, at least, that it is not due to effused blood, nor to colouring matters circulating with the blood, nor to chemical or other agents. Under what circumstances, then, is colouring matter like that seen in cases of bronzed skin deposited from the blood? This is the next step for observation and generalisation.

The knowledge we possess of colouring matter in animal organisms may be generalised under the two heads physiological and pathological, or normal and abnormal. As a pathological form of deposit, we meet with it in two forms; firstly, as *melanosis;* secondly, as the cutaneous discoloration accompanying the irregular action of the chromatogenous glands of the skin seen in pityriasis, lepra, nigrities, etc. Now, in "bronzed skin" we see this difference and similarity; the colouring matter is not (as in nigrities and the others) limited to the surfaces occupied by the chromatogenous glands, for it has been found as small black spots beneath the peritoneum, and in the omentum. In this circumstance, it is similar to melanosis; it is therefore rather analogous in this respect to that pathological change, than to any morbid condition of the chromatogenous glands.

Nor is this the only analogy with melanosis, for we note that, like it, bronzed skin is associated with a cachectic state, chronic, and very slowly progressive, but too often ending fatally. We therefore proceed to tabulate our observations in reference to this analogy. We compare cases of "bronzed skin," and of melanosis. Now, the first glance at the facts shews us that this analogy is only partially correct; for several cases are recorded in which there was not the resemblance to melanosis just mentioned, in regard to the deposit of colouring matter; on the contrary, in this respect the cases referred to resemble nigrities. We have, therefore, two forms of bronzed skin—one which may be considered melanotic, the other cutaneous; we therefore exclude the melanotic cases—setting them aside—having examined them already, and take up those that are cutaneous only. As to these, it at once becomes necessary to investigate the symptoms by fresh synthetical tabulations, so that the facts may be compared with the physiological and pathological phenomena involving the chromatogenous glands, and the deposit of colouring matter generally in the tissues of animals. Now, these phenomena, as we learn from the facts of natural history, extend throughout every kind of organism to the lowest; nor need we stop at animal organisms, for vegetables have their colouring matter too; so that the inquiry at once branches out into two wide and almost uncultivated fields of research, the physiology and pathology of colour in organisms.

The inquiry thus extended would not, however, be conducted without direct reference to the other principal points in the inquiry, namely, the relation of the discoloration to blood-changes, and especially to anæmia on the one hand, and to the functions of the supra-renal capsules on the other.

It is not possible to say what direction collaterally the inquiry would take when once the vast mass of facts in comparative anatomy and natural history was made available. Fresh analogies would certainly be discovered, and fresh trains of researches started, until the subject proper was exhausted. On the threshold we can see, however, several important points for investigation. It is manifest that the discoloration is seen most usually on certain portions of the surface, and noting the special characteristics of those portions, we see that they are the parts covered with hair at puberty. This guides us to the physiological relations of the ovaria and testes, and in connection with these organs, we note an analogy between the bronzing of supra-renal anæmia (assuming theoretically that it is supra-renal), and the nigrities occasionally observed during pregnancy, during the progress of ovarian disease, and in certain cases of amenorrhœa. What, then, are the relations (we might inquire), of the supra-renal capsules to the ovaria and testes? This inquiry brings us to the comparative anatomy and embryological development of this group of organs, and to the relations to them of colour-deposits, or colour-secretion, as seen in lower animals. Again, in "bronzed skin," patches of discoloration are seen on the tongue and mucous membrane of the mouth; this we witnessed lately in a case in the Infirmary. Now, certain animals (mammals and birds), have such discoloration naturally; an analogy which brings it therefore into relation with a very common class of pathological changes in man, namely, the development of a structure or function abnormally, which is normal in other animals, and we consequently take all monstrosities of colour into our inquiry.

EXAMPLE 2.—THE METASTATIC CHARACTER AND GENERAL PATHOLOGY OF GOUT AND RHEUMATISM. I will bring under your notice another illustration of this kind, so as to give you as complete and correct conception as is possible of the modes in which the analogical method may be applied to practical medicine. I must state, however, as distinctly as possible, that in advancing these illustrations, I advance them as theories only.

You are fully aware of the metastatic character of gout and rheumatism, that is, you know how prone an individual is to suffer from inflammation of certain viscera and visceral tissues, who has rheumatic or gouty inflammation of the joints and articular tissues generally. I have actually applied the method of analogy to the elucidation of this, and other points in the pathology of these diseases in this way. As a first step, a sufficient number of facts being collected, collated, and then tabulated for the purpose of comparison, we establish certain differences and resemblances between gout and rheumatism. One resemblance consists in the liability of the serous membranes, the heart and large vessels, and the articular and tendinous structures, to suffer in common; and the conclusion is, that there is a natural analogy between these structures—something in common as to their nature or structure. Now, an inquiry into the structural changes which they undergo in these diseases might elucidate this point, and these may be determined by an investigation directed to their pathological anatomy, both structural and histological. Such investigation has been made, and the result is, that there is a difference in these morbid structural changes, as seen in the two diseases. But a further inquiry shews a similarity in the processes, by which the morbid changes are brought about. There is apparently an irritant, or *materies morbi* circulating with the blood in each form of disease, and whether it be that of rheumatism or of gout, it is determined to these structures, and so morbid changes follow. What, then, is there in common in the histological structure or nutrition of the affected tissues? Turning to the facts of embryological development or formation of these structures, facts at first sight are contradictory; for while the serous membranes, neurilemma, bone, muscles, and motor structures in general are developed from the serous layer of the embryo, and thus a community of origin and nutrition is manifest as to them, the heart and large vessels are derived from another primary tissue—the vascular layer. Hence we conclude that the two classes of organs have, apparently, a dissimilar origin and mode of nutrition. But from what is the vascular layer itself derived? From the union of the two primary, the serous and mucous, so that it is in strictness a sero-mucous layer. Now, the mucous layer gives origin to the viscera of vegetative life, and these are made up of tubes having two structures and two functions. The one is non-striated muscular fibre, with a motor function; the other is mucous membrane, with an excreting, secreting, and absorbing function. They are, therefore, muco-tubular. In the heart and blood-vessels, however, the mucous element is not developed, but only represented by a thin epithelium; the tubulo-motor, or serous element, therefore, is that which is actually developed in these structures; they are, in truth, sero-tubular; consequently there is a real unity of origin and function in the structures affected in gouty and rheumatic disorders.

But in the tabulation or collocation of the primary facts there were certain residual conclusions and differences. How is it (we inquire) that the skin, the mucous membranes, and certain viscera are affected in gout as well as those just indicated? There are several analogies which can be made starting-points of this inquiry. For example (to follow up the conclusion already come to), we can note that the serous element of those viscera which are developed from the vascular layer, but endowed with the structures of the mucous layer, may be more or less predominant in them, and where more predominant, changes analogous to those taking place in the heart and large vessels may more predominantly occur. We may place in this class the larynx, trachea, and bronchi—muco-tubular structures in which the histological development of the motor portion rises from muscular fibre, through aponeurosis, tendon, and cartilage, to bone. In this way we explain gouty affections of the lungs; for we see an analogy between them and the other affected tissues. For similar reasons affections of fibrous or cartilaginous structures of the skin and its appendages may also be classed here, as of the nose, of the ears, the sclerotic coat of the eye—that is, from analogy of predominant structure. More decisively, however, from both analogy of development, of histological structure, and of function, we can class under a common head the air-cells (they having no mucous element, but only the serous, like the vascular system), together with all those tubular structures, the function of which is analogous to that of the heart, namely, simply to transmit a fluid, as the veins, the lymphatics, the urinary and biliary ducts, and spermatic vessels. The tissues of these organs may be expected to undergo analogous diseases and analogous transformations in structure — which is in fact the case; or, in other words, the same changes in the nutrition, circulation, innervation, and special functional activity, which occur in the heart and blood-vessels in the course of gouty affections, will occur in them.

But the mucous membranes, the seat of an excreting and secreting mechanism, are also affected in gouty affections. Now what relation has the functional activity or the structure of these to the *materies morbi* of gout? This inquiry involves an investigation of the nature and sources of the *materies morbi;* and as to its nature, we may observe that all researches, as well recent as ancient, indicate it to consist of some of the excreta (one or more) usually carried off by the kidneys, and very frequently of compounds or modifications of urea, as uric acid and urates. Now the source of these, according to the most recent researches into biochemistry, is in the histogenetic changes of those identical tissues which are specially the seat of gouty and rheumatic affections, namely, the motor apparatus, in the full meaning of the phrase. Thus the theory of a morbid action of such materies morbi upon these structures derives confirmation from their analogies of structure and function, for we can comprehend how, when retained in the blood, it may interfere with their normal histo-genetic changes, and thus be the main cause of that abnormal condition known as inflammation or irritation of these structures, whether it be metastatic or not.

These analogies do not explain to us, however, why the materies morbi should be determined to *mucous* surfaces, until the same principle of unity of structure and function is appplied to the solution of the problem. When one mucous membrane takes on the action of another, the functional activity thus developed is said to be vicarious. Now, in gouty affections, we have vicarious action in this sense, when the salts and compounds of urea are eliminated by other excreting surfaces than those of the kidneys. But both embryology and comparative physiology teach us that there is a community of function, as well as of structure of the mucous membranes, the products of the mucous layer of the embryo, just as physiology and pathology shew us that there is community of structure and function of the products of the serous layer. We can thus, therefore, class together under a common principle both the vicarious and metastatic phenomena of gout. In this way we understand the saline efflorescence on the skin of the gouty; the irritation of the pulmonary, gastro-intestinal, and genito-urinary surfaces to which the gouty are liable, and, in fact, almost all the phenomena of gout.

ILLUSTRATION OF A RESIDUAL PHENOMENON.—But for a long time there was in my mind an important exception to this pathological theory of gout and rheumatism—a residual phenomenon—with which I found it difficult to deal. I allude to that leading characteristic of gout, which consists in an inflammation of, and deposit from the synovial membranes of articular surfaces and tendinous sheaths. As the other facts, however, were harmonious with each other, and with the theory, I concluded, by way of analogy, that these synovial structures were not exceptional instances, but that they were in fact secreting organs, and, therefore, similar to mucous membranes in structure and function. Now within the last two or three years Kölliker and Quekett have shewn by histological researches that this, in fact, is the structure and function of these membranes. They very closely resemble the vilii of the intestinal canal.

ILLUSTRATION OF COLLATERAL RESEARCHES BY THE METHOD OF ANALOGY.—I will not extend this illustration further in the direct line of inquiry, as I could easily do, to the demonstration of the true pathology of rheumatic diseases, but rather will shew you how these investigations branch off collaterally, by an instance within my own experience. Finding that in gouty diseases there was a morbid metastatic and vicarious series of phenomena (I speak now of several years past) from urinary excreta in the blood, I concluded theoretically that when the function of the kidneys was impeded so as to prevent the elimination of these excreta from the blood, analogous phenomena would result; that is to say, morbid metastatic conditions of the serous tissues and vicarious action of the mucous surfaces would take place. Bringing this theory to the test of experience and observation, I found it to be practically true; and I need only refer you to the secondary and tertiary diseases arising in the course of nephria, scarlatinal nephritis, and analogous affections of the kidneys, for proofs. The phenomena, it is true, present a physiognomical difference, because the general conditions of the system, as to age, state of the blood, and the like, are different; but the law of morbid action—the law of selection of structure—and the indications of treatment consequent on those laws, —are fundamentally the same.

I will venture simply to refer you to one or two other illustrations, drawn from my own experience, of the application of this method of analogy to pathology, and of its direct and collateral bearings. Nearly twenty years ago I investigated, in this way, some cases of hysteria brought under my notice at the York County Hospital. I published the result of part of these investigations in the "Edinburgh Medical and Surgical Journal" for 1838, 1839, and subsequently in a separate treatise in 1840. In these volumes you will see how researches thus conducted branch out, and extend onward, until both the lowest and highest phenomena of life and mind are involved in the inquiry.

## EXAMPLES OF APPLICATIONS OF THE METHOD OF ANALOGICAL RESEARCH TO ANATOMY, PHYSIOLOGY, AND HISTOLOGY.

1. Histology of the Skin.—I have hitherto limited my remarks and illustrations almost wholly to pathological research; perhaps it is superfluous to

remark that the analogical method is equally applicable to anatomy, physiology, and histology. In histological researches it constitutes a powerful mental microscope of no mean value. To mention examples:—The skin is derived from the same primordial elements as the muco-tubular system; it is, as is well known, an intestinal tube turned inside out. The derma proper, therefore, corresponds to the non-striated motor element; and we should expect to find this element in some portions of it in man (as the scrotum) and under certain conditions, in lower animals, just as we should expect to find some of the diseases to which it is liable, to belong to the sero-fibrous group. Now, recent histological researches have demonstrated the existence of this element in the derma.

2. GENERAL ANALOGY OF THE TUBULAR-MOTOR STRUCTURES.—Take another illustration of this kind. The heart, we have seen, is evolved out of the combined serous and mucous layer of the embryo. In the lowest forms of animals in which there is a distinct mechanism of vessels, the heart is simply a contractile tube; it is, in fact, analogous to the muco-tubular system, from which it is evolved. It therefore in its sim-

plest form exhibits peristaltic or oscillatory movements, like the intestinal or visceral tubuli. It is only as the viscera generally are specialised that the special mechanism of a heart is evolved. Now, according to the principle of unity of structure and function, we might expect that, under appropriate conditions, the veins, lymphatics, and other tubular structures which I enumerated a moment ago, as presenting community of pathological or abnormal conditions, will also present community of normal structure and function. Let us take the venous and lymphatic circulation as examples. The heart in its simplest form is a dilatation of a vessel—a sinus—having contractile properties. It is through a succession of developments that the heart is formed, as it is seen in mammals. It is equally so with the lymphatics and the veins. In many fishes certain lymphatic vessels dilate into contractile sinuses; in reptiles these appear as pulsating hearts. Similarly with the venous system of vessels in some lower forms, *e.g.*, the genus Pelonaia of the Tunicata, the same vessel is both arterial and venous—it is simply a contractile trunk-vessel, with a somewhat peristaltic action, in which the blood oscillates rhythmically in one direction as arterial blood, in the opposite as venous. In the bivalve mollusca the venous circulation is distinct, and is carried on by a system of contractile sinuses; these appear in the cephalopoda as branchial hearts, or analogues of the right ventricle. In the lowest vertebrate animal, the lancelot or amphioxus, there is the lowest type of circulating apparatus, for the impelling power is derived from a number of pulsating sinuses or dilatations. A minute contractile bulb is found at the origin of each branchial artery, and a pulsatile dilatation or venous heart is developed upon the great dorsal vein, and another upon the trunk of the vena portæ.

Such being the proofs of the correctness of the analogy as to the arterial, venous, and lymphatic systems, let us inquire whether it has been found to be correct as to other portions of the tubular system. If it be a correct analogy, then the tubes carrying fluid secretions should manifest structures and functions similar to those of the other tubes mentioned, and accordingly this has been found to be the case. Claude Bernard found that the choledochus and pancreatic ducts in birds have rhythmical movements. So also Dr. Brown Séquard has shewn to the Societé de Biologie that almost all the excretory ducts of glands in birds manifest these movements. He has seen them in the urinary ducts and vasa deferentia as well as in the biliary and pancreatic ducts. That the pulmonary tubular system does not form an exception to the law of analogy, is shewn by the observations of Dr. Brown Séquard, who has seen rhythmical contractions at each expiration in the trachea and bronchi of large sea-birds. I need hardly add that these muco-tubular structures should, according to the same law, offer examples of sinuses and pulsating hearts, under circumstances in which such structures become necessary. The urinary bladder is an illustration of such a sinus; I know of no example of a muco-tubular pulsating heart, for I know of no conditions under which these structures are developed so as to require constant and rapid emptying. A near approach to these conditions takes place when a morbid state induces irritability of such dilatation or sinus; we have then a muscular structure like the carneæ columnæ of the heart developed, as in certain forms of hypertrophy of the urinary bladder, stomach, etc.

Classification of Analogies. — The physiological analogies available to medical science, of which the preceding are very simple examples, are almost infinitely numerous. The most important may be classed under three heads; the first would comprise analogies of structure in regard to nutrition of tissues; perhaps the terms materialization or histogenesis would better express the nature of the process. The second would comprise vital mechanics, or the construction of organs in regard to the wants of the organism. The third would comprise vital dynamics, or the uses of the organs constructed, including mental physiology.

I would, in reference to the first class, recommend to you this method of analogy as the best adapted for determining the true nature of degeneration of tissues, of morbid deposits, and of the phenomena of inflammation. Illustrations of the adaptation of the method to vital mechanics, phenomena of the second class, I have just given to you. For illustrations of its value when applied to vital phenomena of the third class, I would refer you to my own researches into the physiology of the brain. In my first essay, devoted specially to the subject (published in 1840), I shewed the analogy as to structure and function between the spinal and encephalic ganglia; in my second essay, published last year, I shewed the analogy between the operations of the structures of plants and animals to given ends without consciousness, and the operations of the human cerebral ganglia to given ends without consciousness. By this comprehensive analogy we are enabled to compare these two most extensive classes of phenomena, in so far as the material or molecular changes in living matter are concerned in vital adaptations; and, as the result of that comparison, to reach to the solution of that large and all-engrossing problem of humanity—namely, the true relations of the organ of the mind to mind. Such knowledge is, I need hardly say, but the commencement of a new set of analogies—the radix of fresh tabulations and comparisons, involving all the philosophical, moral, and social questions that have occupied the minds of men.

OBJECTIONS TO THE ANALOGICAL METHOD CONSIDERED.—There are various objections more or less valid that may be raised against the use of this method, and I will notice some of them.

First, It is objected that it is too laborious for ordinary purposes. The answer is, that the inquirer may labour much or little, as he thinks right, only if he will attain to great results, he must greatly per-severe. It is wholly a question as to the limits he will assign to himself.

Secondly, It may be objected that it is a process which, when fully carried out, never comes to a termination, but, on the contrary, the field of inquiry is widened continually. This is true in fact, but it proves the method to be true in fact, for according to the fundamental principle of unity, every phenomenon or group of phenomena, is in relation to all the rest. Consequently, in proportion as we extend our knowledge of these relations, we necessarily widen our generalizations. From whatever link of the chain we begin, we at last work through all. If, indeed, it so happens that we come to a pause, and the circle of relations really ceases to expand, then we may conclude—not that we have exhausted the question, but that we have made a false step somewhere. The laws of gravity would cease to be laws if they were not applicable to the fall of a feather as well as to the movements of the universe; so it is with the laws of life. They include by their very nature, the smallest as well as the largest groups of phenomena; this is as true as the axiom that the whole is equal to the sum of all its parts. It is quite certain that false analogies and the theories and researches founded thereon are equally expansive as the true; but there is this noticeable difference, that the false continually diverge from the real order of events, and the true relations of things to each other; the true continually converge to them, and so demonstrate and connect them. The false become more and more speculative and mysterious, the true become more and more practical and intelligible.

Perhaps the most serious, because most troublesome objection, is, that the analogical method, even when rightly used, leads to researches far too transcendental and impracticable for the ordinary uses of man. I need only say, in answer to this objection, that since it is considered a merit in machinery of human construction, to be able to perform the smallest as well as the largest operations, so I think it must be considered a merit in this method that it is wholly within the volition of the user to what extent he will make it transcendental. Just as Nasmyth's steam hammer will crack a nut or crush an elephant with equal ease and precision, so will this method crack the shell of the smallest as of the largest problem in philosophy. "Transcendental" and "impracticable" are but relative terms; as every thinking man now knows; they are in the mind of the thinker, not in nature. When the electrician was trifling with his pith-balls and the vivisector with the nerves of a frog, they dealt with no less forces than those which are now in daily use, to transmit messages with the fleetness of lightning, or to rend into its elements the most intractable of matter.

HINTS AS TO THE USES OF THE ANALOGICAL METHOD.—I will now give you a few hints as to the uses of this method of investigation by analogy:—

1. Since it requires as complete a knowledge of the phenomena of life as you can attain, you must make it a habit to look largely and comprehensively forth upon these. Ever be reading in the great book of nature; collate curiously all new contributions to the science of life and organization. To you vegetable anatomy and physiology are not less important than animal; comparative pathology not less than human.

2. Look constantly at vital phenomena as a whole; never separate in thought the study of man from the study of all those organisms which co-exist with him. His body is truly a microcosm—a little world of life, in which all modes of life are in some way or other, at some period or other, represented.

This is a fact to be always acted upon, whether your perceptive powers are engaged in observing phenomena, or your intellectual in comparing them and forming analogies.

3. Take care that the foundations of your analogies be facts, and not general terms, or mere expressions of general facts. For example, pathological anatomists speak of fatty "degeneration" or "calcification." The *facts* are, that fat, or the salts of lime, are deposited in tissues in which, under ordinary circumstances, they are not deposited. Degeneration and calcification indicate theoretically the processes by which these deposits take place. Those terms, therefore, do not express facts, only theories. "Tuberculous," "inflammatory," and all similar terms belong to this category.

4. See that the points of comparison upon which you found your analogies be really such as are comparable. Jenner believed he saw an analogy between the curative influence of morbid states like vaccine cutaneous inflammation, and that induced by the application of tartar emetic to the skin. But in fact there was no true analogy between the groups of phenomena which he compared. The agent, the entire series of processes, and the final result, differ

wholly. The only true analogy is in the condition of the skin, as to its being the seat of circumscribed inflammation—a phenomena common to an immense number of diseases.

5. Choose by preference the simplest and most general facts for your analogies. For example, the formation of sugar in the organism in diabetes is a vital process. As a vital process simply, it is analogous to the formation of sugar, as a vital process simply, in all other organisms, whether animal or vegetable, and by whatever structure or organ. Next come analogies of special processes in vegetables and in animals.

6. Having drawn from well-established facts an analogy which includes phenomena not yet observed, and the knowledge of which is necessary to the confirmation of the analogy, multiply and vary the observations or experiments required in every possible way, so as to secure as perfect accuracy as is possible, before rejecting or accepting the analogy. If opportunities be not afforded you to secure this accuracy, neither reject nor accept, but set the analogy aside until they are afforded.

7. Observe, and experiment, and record the results in such a way, that although you may fail to

confirm the analogy, the facts and observations may admit of being variously combined and compared in future, and so subserve to the construction and proving of new analogies.

8. Keep a constant guard on the imagination, by bringing all theories to the test of observation and experience, and by aiming always at practical ends; and by practical ends I mean, additions to our knowledge of practical medicine, or additions to our knowledge of the facts and phenomena of medical science. There is a great danger to be avoided, in the wild speculations which imperfect and false analogies inevitably generate. Some of the most mischievous and most baseless errors in science have arisen from the use of these.

9. The perception and comparison of appropriate phenomena, and the construction of analogies, is an art to be gained only by practice, and by careful study and imitation of the best models; when gained, the art is applicable to the extension of scientific truths, just in proportion to the existing knowledge of the investigator. Without accurate knowledge, the analogical method is a dangerous, if not a useless instrument of research.

CONCLUSION.—I have now completed the task I proposed for myself, and have afforded you an elementary view of the principles and methods of medical observation and research. It is confessedly simple and imperfect, and must be considered as nothing more than an introduction to the severer studies of logic, and of the principles of the inductive philosophy. If what I have said should awaken in you a desire to examine diligently the mental processes by which the human mind acquires a knowledge of the order of nature, and should in any degree render that all-important study easier, my aim in these lectures will have been attained. Nothing has so obstructed the progress of medical science as ignorance of this important branch of knowledge. Nothing will advance that science more than the adoption of true methods of research. Permit me, then, most earnestly, in parting, to commend this knowledge and these methods to your daily thoughts.

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